THE IRON TRADE REVIEW

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ORE BUYING

STARTS WITH A BLOCK OF FIFTY THOUSAND TONS,

But Furnace Men Show Little Interest—Increased Production of Pig Iron—Some Activity in Basic in the East.

The progress which has been made toward the resumption of normal conditions in the iron business is indicated by our blast furnace statistics, which show that the production of pig iron for the first half of the year was 6,789,463 tons, while for the second half the production was 8,885,123 tons. For December, the production was 1,722,557 tons, an increase of 140,243 tons over November. The second blast furnace has been blown in at the new plant at Gary, Ind.

First Iron Ore Sale

The first sale of iron ore for the year has been made, it being a block of 50,000 tons of non-Bessemer. The price is not stated. No other sales are in immediate prospect, and very little interest is shown by blast furnace owners, although there are occasional inquiries as to probable prices.

Pig Iron Conditions

In pig iron there has been some activity, an inquiry for 10,000 tons of basic being current in the Philadelphia district, and one for 6,000 tons at Cleveland. It has just become known that several weeks ago one of the largest eastern Pennsylvania plants purchased 60,000 tons of basic. The sale of 10,000 tons of low-phosphorus iron by an eastern Pennsylvania interest, made two weeks ago, has also just been announced. A New England machinery manufacturer has purchased 6,000 tons of foundry iron, and an Ohio stove concern 1,000 tons. It has been found in many cases that melters exceeded their requirements for the first quarter of the year, and considerable iron is now being delivered on old contracts. The leading Buffalo blast furnace interest last month made and delivered more iron than ever before in its history.

Railroad Buying

It is reported that the Canadian Pacific has placed an order for 20,000 tons of steel rails with the Algoma Steel Co., but the railroads in general are very slow in coming into the market. The Escanaba & Lake Superior is in the market for 50 flat cars, and the Birmingham Southern has ordered 160 all-steel hopper-bottom coal cars from the Pressed Steel Car Co. During December, 142,000 kegs of spikes and 70,000 kegs of bolts were sold in the Chicago district, where the light rail tonnage amounted to 6,000 tons. The city of Chicago has purchased 5,500 tons of cast iron pipe from the United States Cast Iron Pipe & Foundry Co. Duluth and Minneapolis will soon make contracts.

Structural Material

In San Francisco bids have been submitted on about 2,500 tons of structural material, and several contracts for fair tonnages have been let. Contracts taken by the American Bridge Co. include 1,500 tons for R. H. Stearns Bros., Boston, and this company will probably take the contracts for the two Prudential Life Insurance buildings, which will require 7,000 tons. The company's December bookings amounted to about 30,000 tons, the largest for any month of the year with the exception of November.

Coke and Old Material

A Cleveland furnace interest has purchased 45,000 tons of coke for second quarter requirements. There is increasing difficulty in the Connellsville region in obtaining labor at the coke ovens, owing to the number of men who went to their old homes in foreign countries at the time of the depression last year. Scrap in most centers is dull, and in Chicago there is some evidence of weakness.

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MILLIKEN RECEIVERS CONTINUE.

(Special Telegram.)

New York, Jan. 6.—The receivers of Milliken Bros. have been authorized to continue the business until March 1. In their petition for this extension, the receivers stated that a plan of reorganization which met with the approval of more than half of the creditors had to be given up because it was found impossible to raise a fund of $1,500,000. Another plan is under consideration and is expected to result in something definite by the limit set.

THE WEEK IN IRON CENTERS

PITTSBURG

Market is Quiet, but Cheerful Feeling is Predominant.

Office of THE IRON TRADE REVIEW,
510 Park Bldg., Jan. 5.

Generally the iron and steel market is quiet, but there is a spirit of expectancy shown that is keeping makers in a cheerful mood. The doubt over the extent of the likely revision of the tariff continues to inject uncertainty into the situation, which is keeping buyers within cautious limits. Some iron and steel makers, because of this questionable factor, express the belief that the first half of the year will witness but few price changes, if any, in finished material, although it is firmly expected that there will be a gradual increase of business over this period. The generally accepted view is that the last half of the year will find the industry running close to normal lines. Some large manufacturers in this district are now covering for their requirements of iron and steel material as far into the future as the mills will accept the business, reflecting their stronger confidence in the process of recovery now under way.

The pig iron market is not showing much renewed life, but prices continue fairly firm. The largest sale of the past week was 1,500 tons of basic to a steel maker in this district for first four months' delivery. The price range is from $15.75 to $16 valley on small lots, but on attractive tonnages the former figures may be shaded. The long term contract between the Pittsburg Steel Co. and the Penn Coal & Iron Co. operating the Canal Dover stack, for 6,000 tons monthly, began to run Jan. 1. Bessemer iron is dull at from $16.50 to $17 valley. The average price for December was $16.50 valley or $17.40, delivered Pttsburg, compared with $15.84 valley or $16.74 Pittsburg in November. The average was computed upon light sales. Foundry transactions are few. One lot of 500 tons of prompt iron sold on a basis of $15.75 valley. A sale of 50 tons of mottled iron brought $14 at a furnace not in the valleys.

Sheet and tin bar consumption is increasing with a better outlook in sheets and tin plate. During December a substantial increase on sheet bar shipments from makers' mills was recorded. Billets are stationary. Steel bars show little change, but there is a greater buying volume in bar iron.

There are no developments in rails in additional contracts placed by the large steam lines. The rail business of the Carnegie Steel Co. has been gradually increasing, mainly from miscellaneous sources, including the traction lines, lumber companies, coal companies and the general users of light rails, and orders ranging from 1,000 tons down are being steadily taken. In light rails, the company ended the year with a flourish, booking approximately 2,600 tons in the final week, which was the highest weekly figures in domestic orders reached during 1908. As a result of the improved demand, the rail mills of the Edgar Thomson works are operating more consistently. It is expected that the 35,000 tons of the Pennsylvania order allotted the company will be rolled shortly upon the receipt of formal specifications. The Carnegie Steel Co., which, at the start of 1908, carried a large unspecified rail tonnage into the new year, has greatly reduced these held-up bookings and starts 1909 in a much improved position.

A BRIGHT OUTLOOK.

The year 1908 will pass into commercial history as one of the most trying in the memory of men now actively engaged in business.

The situation, however, is rapidly clearing and we look forward with confidence to the coming year. Our immense natural resources in mine, quarry and forest, supplemented as they are each year by bountiful harvests, form a solid basis of prosperity which, when utilized by the untiring energy of an alert people, place beyond serious question the future well being of our country.

Speaking particularly of the steel trade, the outlook is good. Even during the past year the volume of general business has been fairly satisfactory, and now that the railroads are beginning to place their orders for rails and equipment, we can confidently expect, not a boom either in volume of business or prices, but a good healthy growth and a speedy return to normal conditions.

WM. E. COREY,
President United States Steel Corporation.
New York, Dec. 29.

Among the structural contracts placed in the week was the fabrication of 2,500 tons for the new plant of the Crane-Best Co. at Oakmont, Pa., awarded by H. L. Kreusler, Pittsburg, the general contractor, to the American Bridge Co. and the Riter-Conley Mfg. Co., the former receiving the machine shop and the latter the foundry building. The fabrication and erection of 1,000 tons for the additions to the open-hearth department of the Allegheny Steel Co. at Brackenridge, Pa., was awarded to the Bollinger-Andrews Construction Co. The Pittsburg Bridge & Iron Works also took the contract for a large addition to the plant of the Vulcan Crucible Steel Co. at Aliquippa, Pa.

Holiday suspensions of plants have been short, and the new year starts with a slight increase generally in active works capacity. The American Steel & Wire Co. Monday started operations in that portion of its Donora steel works, Donora, Pa., taken over from the Carnegie Steel Co. several months ago. One blast furnace, six open-hearths and the blooming mill, or about 50 per cent of the capacity of the works, were put in operation. The American Sheet & Tin Plate Co. entered the new year with 114 sheet mills or 61 per cent of capacity in operation, the Vandergrift plant of 37 mills, the company's largest works, having resumed this week. In tin plate, 136 mills, being 56 per cent of the total capacity of the company, are running. The Carnegie Steel Co. has blown in one furnace of its Isabella group on ferro-manganese, and now has 32 out of 55 stacks making iron. The active finishing capacity of the company is about 60 per cent. The Republic Iron & Steel Co. is running all its nine furnaces, north and south, with the exception of Hazelton No. 2, and has seven of its 10 mills, including its steel works, in operation, the idle plants being Toledo, Alabama and Gate City. The latter will resume in a few weeks, as previously stated. The Kittanning Iron & Steel Co. Jan. 4 turned on the blast to its rebuilt Rebecca furnace at Kittanning, Pa., and is making foundry

and forge. The iron mill of the company will resume in full Jan. 11, when the 33 puddling furnaces will be started. The Shenango Furnace Co. has blown out its No. 3 stack for rebuilding.

The regular schedule of prices on various iron and steel products is omitted this week, but there are no changes to be noted. The annual review of the Pittsburg market will be found on pages 43 to 47 of this issue.

CHICAGO.

Orders and Inquiries for Cars—Chicago Buys Cast Iron Pipe.

Office of THE IRON TRADE REVIEW, 1328 Monadnock Block, Jan. 5.

Another week of quiet is to be recorded. No especially noteworthy transactions featured the closing days of the year, but a moderate run of business is reported. Pig iron sales were light, but capacity is well sold up for the first quarter and there are several good inquiries in the market. The Illinois Central railroad inquiry for iron bars remains in the same status. A moderate activity in billets has prevailed. Steel bar specifications did not fall off appreciably, but plates and sheets moved very slowly. The structural contracts placed were almost entirely for very small tonnages. At this writing, it is authoritatively reported that the contracts for the Hart-Shaffner-Marx building and the new city hall have not been signed. With the exception of the report that the Canadian Pacific railway has placed a contract with the Algoma Steel Co. for 20,000 tons of rails, there are no new developments in the heavy rail situation. Railroad buying has been largely confined during the month to track fastenings. The Escanaba & Lake Superior is in the market for 50 40-ton flat cars and the Birmingham Southern has ordered 160 all-steel hopper bottom coal cars from the Pressed Steel Car Co. The city of Chicago has ordered 5,500 tons of pipe from the leading pipe interest, and Duluth and Minneapolis are in the market for moderate requirements. Old material apparently is somewhat weaker despite the comparatively small tonnage of scrap coming out. It is reported that some of the railroads are unable to move scrap already sold, for lack of shipping instructions. The only wonder is that this condition has not arisen before during the long period of curtailed mill operations.

Pig Iron.—A number of inquiries for moderate tonnages up to 600 tons are in the market aggregating about 2,000 tons, in addition to which there is reported a single inquiry for 2,000 tons. The inquiry for 8,000 tons of basic reported as in this market was not circulated generally and has been withdrawn. The sales of the week were light and confined to small lots. It is generally believed that the buying in October and November was based on an overestimate of actual requirements as developments have shown them to be. This has not resulted as yet in any degree of holding up on shipments, but it will undoubtedly postpone any concerted buying in the near future until actual contracting for castings increases sufficiently to justify it. In the south, the furnaces are fairly firm at the $13 level for Birmingham No. 2 irons and are pretty well sold up for the first half of the year. One interest which has been particularly active is inclined to ask $13.50 but higher prices can only come, it would seem, with a larger buying than has ruled in the last month. Local irons are supported in part by the southern situation and are selling in limited quantity at about the normal differential above southern irons. We quote for delivery through the first half, as follows:

Lake Superior charcoal	$19.50
Northern foundry No. 1	18.00 to 18.50
Northern foundry No. 2	17.50 to 18.00
Northern foundry No. 3	17.00 to 17.50
Southern foundry No. 1	17.85 to 18.35
Southern foundry No. 2	17.35 to 17.85
Southern foundry No. 3	16.85 to 17.35
Southern foundry No. 4	16.35 to 16.85
Southern No. 1 soft	17.85 to 18.35
Southern No. 2 soft	17.35 to 17.85
Southern gray forge	15.60 to 16.10
Southern mottled	15.35 to 15.60
Southern silveries, 4 per cent silicon	18.10 to 18.60
Southern silveries, 5 per cent silicon	18.35 to 18.85
Southern silveries, 6 per cent silicon	18.85 to 19.35
Jackson Co. silveries, 6 per cent.	19.90
Jackson Co. silveries, 8 per cent.	20.40 to 20.90
Jackson Co. silveries, 10 per cent.	21.90
Malleable Bessemer	17.00 to 17.50
Standard Bessemer	17.65 to 18.15
Alabama Basic	17.35 to 17.85

Billets.—The western car builders are still covering for their axle billet requirements nearly all of which tonnage goes to the leading interest. A local independent interest furnished 400 tons of billets to a Milwaukee steam shovel manufacturer and several small lots of forging billets were purchased. Billet prices are firm at present and we quote as follows:

4 x 4-inch rolling billets, $26.50, and forging billets, $28.50, base Chicago.

Merchant Steel.—The tonnage of bar iron for which the Illinois Central railroad has been inquiring has not yet been placed. It is now understood that a car building company near Chicago, operating a bar mill, is also a bidder for this tonnage. Steel bar specifications are well maintained. There are no changes of interest to report in connection with mill operations. The leading interest reports that December production records for its western mills were ahead of any other month in the year. Prices are unchanged and we quote:

Bar iron, 1.50c to 1.53c; soft steel bars and bands, 1.58c, half extras; soft steel angles, less than 3 x 3, 1.68c; hoops, 1.98c base, full extras; planished or smooth-finished tire steel, 1.78c; iron finish, up to 1½ x ½-inch 1.73c base tire card; iron finish, 1½ x ½-inch and larger, 1.58c base steel card; channel for solid rubber tire, ¾ to 1 inch, 2.08c; and 1⅛ inch and larger, 1.98c; smooth-finished machinery steel, 1.83c; flat sleigh shoe, 1.63c; concave and convex sleigh shoe, 1.83c; cutter shoe, 2.95c; toe calk steel, 2.13c; railway spring, 1.93c base steel card; vehicle spring steel, 1.98c base vehicle card; crucible tool steel, 7c to 9c, with higher prices asked on special grades. Quotations on shafting are 56 per cent off the list for carload lots, and 52 per cent off for less than carload lots, carload freight allowed to points in base territory. On iron and steel bars from local stocks, we quote as follows: Bar iron, 1.90c to 2c, full extras; soft steel bars, 1.80c per 100 pounds base, plus half extras; soft steel hoops, 2.30c, full extras.

Plates.—The plate tonnage for the last month has been very small. Orders are made up of small lots that even in the aggregate fail to run into desirable tonnage. Prices are not very firm. We quote for Chicago delivery as follows:

Plates, ¼-inch and heavier, 6¼ to 100 inches wide, either universal or sheared, 1.78c Chicago. For extras see Pittsburg report. Jobbers' prices for shipment from local stocks are as follows: Tank steel, ¼-inch and heavier, up to 72 inches wide, 2c to 2.10c; from 72 to 96 inches wide, 2.10c to 2.20c; 3-16-inch up to and including 60 inches wide, 2.10c to 2.15c; 72 inches wide, 2.35c to 2.45c; No. 8, up to 60 inches wide, 2.10c to 3.15c. Flange and head quality, 25c extra.

Sheets.—A miscellaneous demand for sheets of the lighter gages maintains a fair movement in this product, but trading during the past week was more or less perfunctory. Prices on sheets are adhered to with considerable uniformity. We quote Chicago delivery from store as follows:

No. 10, 2.15c to 2.25c; No. 12, 2.20c to 2.30c; No. 14, 2.25c to 2.35c; No.

16, 2.35c to 2.45c; Nos. 18-20, 2.60c to 2.65c; Nos. 22-24, 2.65c to 2.70c; No. 26, 2.70c to 2.75c; No. 27, 2.75c to 2.80c; No. 28, 2.85c to 2.95c; No. 30, 3.25c. Galvanized sheets, No. 10 to 16, 3.05c to 3.10c; Nos. 18 to 20, 3.15c to 3.25c; Nos. 22 to 24, 3.30c to 3.35c; No. 26, 3.50c to 3.55c; No. 27, 3.70c to 3.75c; No. 28, 3.90c to 4.00c; No. 30, 4.40c to 4.50c.

Structural Steel.—The sub-contracts covering the steel for the new city hall and the Hart-Shaffner-Marx building continue to drag along without signatures and in the case of the latter not even the general contract has been executed, although the placing of the contracts and the parties thereto are quite definitely determined upon. The plant of H. B. Clow & Son, at Coshocton, O., will require 560 tons, the Chicago, Milwaukee & St. Paul is in the market for 500 tons. In San Francisco bids have been submitted on about 2,500 tons including 1,200 tons for the Union Trust Co. building, 300 tons for a hotel building, 300 tons for the Goldberg-Bowen building and 200 tons for a highway drawbridge. The Crane Co. is to build a warehouse at San Francisco in which there will be 664 tons of steel. The contract for this will probably be let to Noble Bros., of that city. Contracts let in the vicinity of San Francisco include 300 tons for the Great Western Power Co., at Oakland, taken by the American Bridge Co., 207 tons for the Feigenbaum building, 125 tons for the Phoenix Realty Co., 208 tons for the Elks Club building, all taken by Dyer Bros., and 345 tons for the Kelly building at Oakland, to be fabricated by the Ralston Iron Works. Locally there has been a fair tonnage of small miscellaneous orders placed, of which the leading interest took about 500 tons. The structural mill at South works is running full on current orders. It is reported from various points that cost figures are still being underbid in competition. We quote mill prices as follows:

Beams and channels, 3 to 15 inches, inclusive, 1.78c to 1.81c, delivered Chicago. For extras see Pittsburg report. Quotations from store are as follows for carload lots and over:

All angles, 3 inches and larger, including 6 inches, $1.95 per 100 pounds; angles over 6 inches, $2.05 per 100 pounds, base; beams, 3 to 15 inches, inclusive, $1.95 per 100 pounds, base; channels, 3 inches and larger, $1.95 per 100 pounds, base. Less than carload lots are $1 a ton higher than foregoing prices.

Rails and Track Supplies.—A report impossible to confirm today has it that the Canadian Pacific railroad has contracted with the Algoma Steel Co. for 20,000 tons of rails. No other transactions in heavy sections are reported. The December totals show sales of 142,000 kegs of spikes and 70,000 kegs of bolts in which direction railroad buying has been unusually heavy. The light rail tonnage for December aggregated about 6,000 tons, which is very good for this month. Prices are without change and we quote as follows:

Standard Bessemer rails, $28; open-hearth, $30, f. o. b. mill in 500-ton lots and over; less than 500 tons, $2 extra, full freight to destination; light rails, 25-pound to 45-pound, $26; 20-pound, $27; 16-pound, $28; 12-pound, $29. Track supplies, f. o. b. Joliet, angle bars, 1.50c to 1.60c; spikes, 1.80c to 1.90c; track bolts, with square nuts, 2.15c to 2.25c; with hexagon nuts, 2.30c to 2.40c. Small railroad and square boat spikes, 1.90c base, f. o. b. Chicago.

Merchant Pipe and Boiler Tubes.—The trade in tubular goods is quiet. We quote mill discounts as follows:

	—Steel—	
	Black.	Galv.
¼ to 6 inches, inclusive.....	73.2	63.2
7 to 12 inches, inclusive.....	70.2	55.2

BOILER TUBES.

	Steel.	Iron.	Seamless.
2¼ to 5 inches, inclusive..	63.2	50.2	50.2

Cast Iron Pipe.—The contract for 5,500 tons of small cast iron pipe for the city of Chicago was placed with the United States Cast Iron Pipe & Foundry Co. The contract for 1,500 tons for the city of Indianapolis is understood to have been awarded to the Lynchburg (Va.) Foundry. Lettings are advertised for this month for from 1,200 to 1,500 tons at Duluth and for 1,700 tons at Minneapolis. Prices are firm and advances are in prospect. We quote as follows:

Four-inch pipe, $27; 6 to 16-inch, $26; larger sizes, $25; gas pipe, $1 a ton higher.

Wire Products.—While the wire trade has been quiet through the holiday season, the volume of business has held beyond expectations. The next few weeks will witness the opening up of spring trade, which it is expected will be heavy. We quote for Chicago delivery as follows:

Wire nails, $2.23; painted barb wire, $2.38; galvanized barb wire, $2.68; smooth annealed wire, $2.08; smooth galvanized wire, $2.38; polished staples, $2.23; galvanized staples, $2.63. Carload lots to retailers, 5 cents higher; less than carload lots, 15 cents higher. Wire rods, Bessemer, $33; open-hearth, $34; chain rods, $33, f. o. b. Pittsburg.

Old Material.—Although railroads are still able to obtain prices within the range quoted a week ago, as evidenced by the prices brought by the Burlington list, evidences of weakness in other directions are not lacking. Scrap previously purchased from some of the railroads is being moved very slowly from the railroad yards, indicating the difficulty with which consumers are being induced to purchase. Under these conditions a shading of prices is a natural necessity. The lists offered for purchase this week include 1,200 tons from the Rock Island, 2,600 tons from the Santa Fe and 3,000 tons from the Chicago & Northwestern, of which last named list 1,000 tons are rerolling rails. The Great Northern railway has issued an unusually large list containing 10,600 tons. In this scrap are 5,000 tons of old iron rails, 1,000 tons of rerolling rails, 700 tons of malleable and 600 tons of cast scrap. We have revised our prices and quote as follows:

Old car wheels	$15.25 to 15.75
Old iron rails	19.50 to 20.00
Re-rolling rails (4 ft. and over).	16.25 to 16.75
Old steel rails (4 ft. and under)	14.50 to 15.00
Light section relayers, 45 lbs. and under, subject to inspection....	21.00 to 23.00
Relaying rails, subject to inspection	19.00 to 19.50
Frogs, switches and guards.....	14.25 to 14.75
Heavy melting steel.....	14.25 to 14.75

We quote, net tons, as follows:

No. 1 R. R. wrought.....	$14.00 to 14.50
No. 2 R. R. wrought.....	13.00 to 13.50
Knuckles, couplers and springs..	13.75 to 14.25
Shafting	16.50 to 17.00
Iron car axles	20.50 to 21.00
Steel car axles	18.50 to 19.00
Dealers' forge No. 1.....	11.00 to 11.50
Pipes and flues	11.00 to 11.50
No. 1 cast, 150 lbs. and less.....	13.50 to 14.00
No. 1 mill	9.00 to 9.50
Mixed busheling (Nos. 1 and 2).	9.25
Country sheet	5.50 to 6.00
No. 1 boiler cut	10.50 to 11.00
Boiler punchings	12.50 to 13.00
Cast borings	7.00 to 7.50
Mixed borings, etc.....	7.00 to 7.50
Machine shop turnings	8.50 to 9.00
Railroad malleable	13.50 to 14.00
Agricultural malleable	11.50 to 12.00
Stove plate and light cast scrap..	12.00 to 12.50
Old iron splice bars.....	16.50 to 17.00

CLEVELAND.

First Sale of Iron Ore—Inquiry for 6,000 Tons of Basic.

Office of THE IRON TRADE REVIEW,
Browning Building, Jan. 5.

Iron Ore.—The first sale of ore for the new year has been made, it being a block of 50,000 tons of non-Bessemer. The price is not stated, and it is not anticipated that this sale will have much influence in fixing prices for next year. Ore agencies uniformly report very little interest on the part of furnace men, although some of them are anxious to know what will probably be the prevailing prices. A moderate amount of ore is

being moved from docks to furnaces. On base ores with the guarantee of 55 per cent on old range and Mesabi Bessemer, and 51½ per cent on old range and Mesabi non-Bessemer, we quote as follows: Old range Bessemer, $4.50; Mesabi Bessemer, $4.25; old range non-Bessemer, $3.70; Mesabi non-Bessemer, $3.50.

Pig Iron.—The market is very quiet, but without tendency to weakness. It has developed in many cases that melters bought somewhat beyond their requirements for the last quarter of the old year, and shipments are being made on contracts on which the fall shipments were not finished before the close of the year. The only inquiry of importance pending is one for 6,000 tons of basic. Cleveland interests report that they have no difficulty in getting $16 furnace for shipments outside of the city. We quote delivered in Cleveland for spot iron as follows:

Bessemer	17.40 to 17.90
No. 1 foundry	$17.25 to 17.50
No. 2 foundry	16.75 to 17.00
No. 3 foundry	16.25 to 16.50
No. 2 southern	17.35
Gray forge	14.75 to 15.25
Lake Superior charcoal	19.50 to 20.00
Jackson Co. 8 per cent silvery	20.05

Coke.—The market for spot coke is somewhat weaker, and in exceptional instances furnace coke on track has been sold as low as $1.55 to $1.60 per ton. There is increasing difficulty in getting laborers in the coke regions. We quote standard furnace coke on contracts for the first half $1.90 to $2, and standard foundry coke $2.25 to $2.50. Furnace coke is sold at $1.55 to $1.70 for prompt delivery and spot foundry coke at $2 to $2.25.

Finished Materials.—Specifications are being received in satisfactory volume by the mills, and there is a fair run of small orders on new business, but nothing of importance is pending. Inquiries for light rails include 400 tons for the Panama canal zone. Rerollers are not giving manufacturers from new steel quite so much trouble as they did a while ago. Bar iron is quiet. The Empire and Union mills are running this week.

The Cleveland Furnace Co. this week purchased 45,000 tons of coke for the second quarter at a figure somewhat below usual current quotations.

Old Material.—Dullness still characterizes the local market, and few sales of any size have been made the past week, even between dealers. The drop of 25 cents a ton on heavy steel is the only price change of moment, and we continue to quote f. o. b. Cleveland as follows:

Old iron rails	$19.00 to 19.50
Old steel rails (re-rolling)	16.50 to 17.00
Old steel rails (under 6 ft.)	16.50 to 17.00
Old car wheels	15.50 to 16.00
Old steel boiler plate	13.50 to 14.00
Steel axles	20.00 to 20.50
Malleable iron (railroad)	15.00 to 15.50
Malleable iron (agricultural)	13.50 to 14.00
Heavy steel	15.50 to 16.00
Country mixed steel	13.50 to 14.00
Low phosphorus	17.00 to 17.50

We quote, net tons, as follows:

No. 1 R. R. wrought	$15.50 to 16.00
No. 1 busheling	13.50 to 14.00
No. 1 machine cast	13.50 to 14.00
Iron axles	19.00 to 19.50
Axle turnings	11.00 to 11.50
Machine shop turnings	10.00 to 10.50
Grate bars	12.00 to 12.50
Pipes and flues	12.50 to 13.00
Tank iron	12.50 to 13.00
Hoop and band iron	9.25 to 9.75
Sheet iron	8.50 to 9.00
Wrought drillings	10.00 to 10.50
Stove plate	12.50 to 13.00
Cast borings	8.50 to 9.00

CINCINNATI.

High Prices for Low Grade Pig Iron—Few Large Sales Reported.

Office of THE IRON TRADE REVIEW,
First National Bank Bldg., Jan. 5.

Pig Iron.—The first week of the new year has not been productive of important transactions in pig iron in this market, but there is considerable scattering inquiry for lots ranging from 100 to 250 tons and some fair sized tonnages have been sold. A local consumer bought 700 tons, 300 tons of which were for first quarter delivery and 400 tons for delivery over the first half of the year. A stove maker at Mansfield, O., closed for about 1,000 tons—500 tons or more of which was southern iron—the prices of these transactions are given out as being $13 Birmingham for southern iron and $15.50 northern furnace for northern iron, indicating that the market is holding well up to the schedule. An indication of strength in the situation is furnished by reported sales of two lots of 500 tons of southern iron in Chicago territory at $13.50 Birmingham for second quarter delivery. An interesting feature of the market is the interest shown by the leading cast-iron pipe makers who have invited offers of iron and it is believed that a liberal tonnage may be taken. Trade talk is to the effect that pipe makers in Virginia and in the east, as well as the leading interests, are scouring the market for low grades, which continue scarce. The producers in the south have made an unusually large proportion of high grade irons for the past several months, and so far as could be learned the offerings of low grades are fairly well cleaned up. A recent sale to a large consumer of southern gray forge at $12 Birmingham is confirmatory of considerable firmness in this grade. The general price situation is regarded as well sustained, with enough orders and inquiry coming in to keep furnaces fairly well satisfied. In southern Ohio the market continues at $15.50 at furnace for No. 2 foundry for the first half; but the bulk of the business done through this market recently appears to have been in southern irons. Jackson county 8 per cent silvery remains quotable at $18.50 at furnace. Shipments on contracts from all districts are going forward in good shape with very few requests for suspensions. We quote for prompt shipment and first quarter delivered Cincinnati, based on freight rates of $3.25 from Birmingham and $1.10 from Ironton, as follows:

Southern foundry No. 1	$16.75 to 17.25
Southern foundry No. 2	16.25 to 16.75
Southern foundry No. 3	15.75 to 16.25
Southern foundry No. 4	15.25 to 15.75
Southern No. 1 soft	16.75 to 17.25
Southern No. 2 soft	16.25 to 16.75
Southern gray forge	14.75 to 15.25
Northern No. 1 foundry	17.10 to 17.60
Northern No. 2 foundry	16.60 to 17.10
Northern No. 3 foundry	16.10 to 16.60
Northern 8 per cent silicon	19.60

Finished Material.—The specifications on contracts were fairly liberal the past week, but there has been some urging on the part of sales agents to bring out tonnages. The jobbing trade has been rather quiet, but prices remain unchanged. Small orders are filled here at the following quotations:

Iron and steel bars, 1.85c to 2c, full extras. Angles, 3 x 3 and over, 2.10c to 2.25c; beams and channels, 15 inches and under, 2.10c to 2.25c; small angles and architectural channels, 2c base; plates, ¼-inch and heavier, 2c; 3-16-inch, 2.10c; No. 8, 2.15c; sheets, blue annealed, No. 10, 2.15c to 2.25c; No. 12, 2.20c to 2.30c; No. 14, 2.25c to 2.35c; No. 16, 2.35c to 2.45c; box annealed sheets, Nos. 18 and 20, 2.55c to 2.65c; Nos. 22 and 24, 2.65c to 2.75c; Nos. 25 and 26, 2.70c to 2.80c; No. 27, 2.75c to 2.85c, and No. 28, 2.85c to 2.95c; boiler tubes, 2¾ to 5 inches, 62 per cent off base; turnbuckles, 45 per cent off; rivets, 3c base; cold and rolled shafting, 47 to 50 per cent off list; steel tire, 2.05c to 2.10c base.

Coke.—Some weakness has developed in prompt shipment furnace and foundry coke, which was in part due to the lessened consumption incident to the holidays, while the production was maintained. The ovens, however, are demanding previous prices on contracts, but foundries take advantage of the present prices obtainable for prompt shipment coke, which are from 35c to 50c per ton less than the figures asked for contracts.

Contract prices in the leading coke producing districts are as follows:

	PER TON.
Wise county furnace coke	$1.90
Wise county foundry coke	2.25 to 2.35
Pocahontas furnace coke	1.85 to 2.00
Pocahontas foundry coke	2.00 to 2.25
Standard Connellsville furnace coke	2.00 to 2.25
Standard Connellsville foundry coke	2.35 to 2.50

Old Material.—While there is no quotable change in the market and dealers are still holding firmly there are rumors of some recessions as the demand does not improve and melters seem inclined to resist the present scale of prices. The market may be described as slightly unsettled but not quotably changed. Dealers' prices here are as follows:

Old No. 1 R. R. wrought, net tons	$14.50 to 15.00
No. 1 machinery, net tons	13.50 to 14.00
Old iron rails, gross tons	18.00 to 18.50
Old steel rails (re-rolling) gross tons	16.50 to 17.00
Old short lengths, gross tons	16.50 to 17.00
Old iron axles, net tons	17.00 to 18.00
Heavy melting scrap, gross tons	14.50 to 15.50
Stove plate, net tons	11.00 to 11.50
Wrought turnings	8.00 to 8.50
Cast borings, net tons	6.00 to 7.00
Car wheels, gross tons	15.50 to 16.00

Elliot Knight, formerly connected with the Cincinnati sales office of the Republic Iron & Steel Co., has accepted a position with the Sharon Steel Hook Co., at Sharon, O. Frank Pund has succeeded Mr. Knight with the Republic Iron & Steel Co. Mr. Pund was formerly with the Kruse & Ballman Hardware Co.

The Cincinnati Steel Foundry Co., with a capital of $50,000, has been incorporated and will occupy the old plant of the L. Jones & Sons foundry on Kenyon avenue, between Baymiller street and Freeman avenue. The incorporators are William Gilbert, John L. Hopper, Salmon P. Jones and John E. Bruce. Mr. Hopper will be in charge of the business, having recently been connected with a steel plant in Minneapolis. The company will manufacture small crucible steel castings.

PHILADELPHIA.

Some Activity in Basic Pig Iron—Heavy Tonnage Recently Closed.

Office of THE IRON TRADE REVIEW,
408 Central Trust Bldg., Jan. 5.

Pig Iron.—Holiday activity in this district has been chiefly confined to basic iron. The past week has witnessed further purchasing to the extent of about 25,000 tons by an eastern Pennsylvania interest which has been particularly active of late in covering its requirements for several months ahead. This last purchase shaded the $17 holding price, as it is known that a furnace company which took about one-third of the business secured $16.75, delivered. A 10,000-ton inquiry is now current and some smaller lots are being figured on, but it seems probable that the $17 figure will prevail hereafter, as several of the largest producers are firm at that level. A further strengthening factor developed during the week when it became known that several weeks ago one of the largest eastern Pennsylvania consumers closed for 60,000 tons of basic. The transaction was carefully guarded and details are not available, though it can be stated that this tonnage normally represents only four or five months' consumption at the purchasers' works. Pipe works have been rather more active than usual of late. One of the largest interests has been figuring on 4,000 to 5,000 tons for New Jersey consumption during the first quarter, and another concern has asked prices on a smaller tonnage. Pipe makers have been very reluctant to keep pace with the advance in iron prices, and in the case of the larger inquiry mentioned sought to cover at about $16, delivered. A 3,000-ton purchase of foundry iron is noted, this covering the purchaser's requirements through the year. The only low phosphorus transaction was a lot of 500 tons placed at current prices. We quote, first quarter delivery at eastern Pennsylvania works, as follows:

No. 1X foundry	$17.50 to 18.00
No. 2X foundry	17.00 to 17.50
No. 2 plain	16.50 to 17.00
Standard gray forge	16.00 to 16.50
Basic	16.75 to 17.25
Low phosphorus	21.50 to 21.75
No. 2 Birmingham	17.75 to 18.25
No. 2X Virginia	17.50 to 18.00
No. 2 plain Virginia	17.00 to 17.50

Finished Materials.—Rail orders have been confined to a lot of 15,000 tons to be rolled at Sparrows Point, for the Philadelphia & Reading, on the same specifications as heretofore. Several important lines are still estimating on their 1909 requirements. Railroads have been specifying generously on plate and structural contracts, particularly for car building work. Steel mills took a good tonnage during December, although orders from jobbers were disappointing. The Terminal Warehouse Co. building at Baltimore, reported last week as going to the Jones & Laughlin Steel Co., will require 1,500 tons of steel. The Cramps have not yet received the collier award, on which their bid was low. We quote: Structurals, 1.75c to 1.90c; plates, 1.75c to 1.80c; refined bar iron, 1.50c to 1.60c; steel bars, 1.55c.

Old Materials.—The situation is without new developments, except that the purchasing agents of a number of mills met Wednesday and no change was made in the price they are offering for heavy melting steel, $17, delivered. Other interests, however, are paying 50 to 75 cents above this figure. No large transactions are reported and we quote, gross tons, eastern Pennsylvania delivery, as follows:

Old steel rails (re-rolling)	$18.00 to 18.50
No. 1 steel scrap	17.25 to 17.75
Old steel axles	22.00 to 23.00
Old iron axles	25.00 to 26.00
Old iron rails	21.00 to 22.00
Old car wheels	16.00 to 16.50
Choice scrap R. R. No. 1 wrought	20.00 to 20.50
No. 1 yard scrap	18.00 to 18.50
Machinery scrap	16.00 to 16.50
Low phosphorus scrap	20.00 to 20.50
Wrought iron pipe	15.50 to 16.00
No. 1 forge fire scrap	15.00 to 15.50
No. 2 forge fire scrap, ordinary	10.00 to 10.50
Wrought turnings	13.75 to 14.25
Axle turnings	15.00 to 15.50
Cast borings	13.00 to 13.50
Stove plates	13.50 to 14.00
Heavy melting steel	17.50 to 18.00

BUFFALO.

Very Little Change in Pig Iron—Finished Material Quiet.

Office of THE IRON TRADE REVIEW,
932 Ellicott Square, Jan. 5.

Pig Iron.—The market has shown very little change with the beginning of the year. While some furnace people rather expected firmer conditions with the beginning of 1909, the majority of them are not surprised that business is not brisk at this time, but all of the furnace people feel that business conditions are good and the tendency continues towards a good tone in pig iron and firmer conditions generally.

There has been no change in quotations and it would appear now that prices will be maintained for the present. Inquiries for tonnage are coming in fair number, although very few inquiries run over 1,200 tons. Most of the business which is being placed at this time is for tonnage less than 500 tons while the larger business ranges between 500 and 1,200 We quote f. o. b. Buffalo as follows:

No. 1 X foundry	$16.75 to $17.25
No. 2 X foundry	16.25 to 16.75
No. 2, plain	15.75 to 16,25
No. 3	15.50 to 15.75
Malleable Bessemer	17.00 to 17.50
Gray forge	15.25 to 15.50
Charcoal	20.50 to 21.00

Finished Products.—The opening of the year in this territory shows a rather apathetic condition so far as the demand for finished material is concerned and the number of specifications for business seems to have fallen off, but it is believed that this condition is only temporary. Most of the activity in finished products is found in cities down the state rather than in Buffalo, as business of this character is particularly quiet in Buffalo at the present time. The demand

for galvanized plates is reported as good just now and prices are being maintained. In this connection the conditions of business have shown a steady, healthy improvement for several weeks past, such as would give the producer substantial encouragement. While the increase of business is far from being of a boom character, the slow but certain progress which has been made is gratifying.

SEATTLE.

All Lines Quiet Except Tin Plate—Spot Pig Iron High.

Office of THE IRON TRADE REVIEW, 302 Pioneer Bldg., Jan. 2.

The new year opens with quietness reigning in all lines except tin plate, but with the volume of business so improved over six months ago as to presage active and normal business during 1909. The most important announcement to the iron trade of the Pacific coast during the past week was that of the reorganization of the Irondale Furnace Co. into the Irondale Steel Co. of Seattle, which new corporation intends to proceed actively with the manufacture of iron and steel in the state of Washington. Lumber prices have advanced recently and this important branch of the north coast's business is in a strong position, resulting in activity in logging engines, wire rope, light rails, etc. The commencement of work on the Idaho & Washington Northern railroad near Spokane is bringing a demand for contractors' machinery and supplies in that territory. Bar iron and steel is quiet and firm. The rolling mill at Seattle is operating and the one at Portland will be reopened in a short time. The Oregon Iron & Steel Co. expects to start up its Oswego cast iron pipe foundry in the near future. Specifications on tin plate for the coming Alaska salmon pack are still heavy. There has been a lull in heavy marine repairs and a number of machine shops engaged in this business are temporarily operating on reduced schedules.

Pig Iron.—The movement for the past two weeks has been very light. Prices at Portland have sagged a little as low as $23 being quoted for imported English No. 2. There has been no recession of prices at any other points and the general market is still firm. Heavy storms have delayed the arrival of expected cargoes of pig on Puget Sound; so stocks are still very low and spot iron consequently high in price; $27 being the ruling figure for English No. 1. We continue to quote:

English soft, No. 1, spot	$26.50 to 27.00
English soft, No. 1, to arrive April-May	24.00 to 24.50
Glengarnock No. 1, spot	28.00 to 29.00
Southern soft, No. 2	26.70 to 27.20

Prices are for gross tons ex ship in the case of imported on "to arrive" or ex warehouse for spot imported or domestic. The only domestic iron offered is southern No. 2 from Alabama.

Old Material.—The scrap market has undergone but little change in the past two weeks. The foundries are buying in limited quantities and dealers are not inclined to shade prices. We continue to quote net tons, f. o. b. Seattle:

Foundry and machinery scrap	$17.00 to 19.00
Old steel rails	8.00 to 9.50
Railroad wrought	10.00 to 11.00
Country wrought and busheling	5.00 to 7.00

Coke.—Stocks of foreign coke on the Pacific coast are very low, but prices are inclined to be weak. The movement of local foundry coke is normal and up to expectations. Imported English and German foundry coke for future delivery is quoted at $10 to $12 per net ton ex ship at Pacific coast ports; foreign coke for immediate delivery is bringing from $12 to $13.50. Local domestic foundry coke is $6.50 to $8.50 per net ton.

Merchant Iron.—The heavy December movement due largely to the advanced freight rates taking effect Jan. 1 has largely spent itself and rolled products are expected to be quiet for the first six weeks of the new year. About 1,000 tons of mild steel and Norway iron bars are now being imported from Europe, but are selling at the same price as domestic products. The movement of mild steel in the San Francisco territory where a price of $2.35, base, per 100 pounds was recently fixed, is improving. We quote base prices per 100 pounds f. o. b. Seattle: Common iron bars, $2.25; soft steel bars, $2.35; machinery steel, $2.75; Norway iron, $3.50; angles, channels, zees and tees, under 3-inch, $2.75.

NEW YORK.

Pig Iron Quiet.—Structural Contracts Let and Pending.

Office of THE IRON TRADE REVIEW, Room 1005, No. 90 West St., Jan. 5.

Pig Iron.—The market is quiet and without feature, although small sales are sufficiently numerous to aggregate a fair tonnage. Activity is chiefly in foundry iron, a New England machinery manufacturer having closed for 6,000 tons for first half delivery and other less important sales being reported. Malleable is quiet, though considerable business is in prospect, particularly in New England. The sale of 10,000 tons of an eastern Pennsylvania iron running low in phosphorus has been announced, although made a fortnight ago. We quote first quarter delivery at New York tidewater as follows:

Northern foundry No. 1	$17.75 to 18.25
No. 2X foundry	17.25 to 17.75
No. 2 plain	16.50 to 17.00
No. 2 southern foundry	17.25 to 17.75
Malleable	18.00 to 18.50
Basic	17.00 to 17.25
Gray forge	16.25 to 16.75

Ferro-Alloys.—Practically all the activity of the past week has been concerned with a lot of ferro-manganese available for immediate delivery, of which some 400 tons were sold at a shade under $44, seaboard. For future shipment, the price is about $1 higher. During the week, about 250 tons of 50 per cent ferro-silicon sold at about $63 Pittsburg.

Finished Material.—The American Bridge Co. has secured the steel, nearly 1,500 tons, for R. H. Stearns Bros., Boston, and will probably take the two Prudential buildings requiring 7,000 tons. The St. Paul railroad is inquiring for 500 tons of girder spans, having placed 300 tons of bridge work with the Minneapolis Steel & Machinery Co. Early awards are expected on a 900-ton foundry building for the Falk Co., Milwaukee, on 1,600 tons for barge canal bridges for the Whitehead & Kales Co., Detroit, on a 600-ton building for Clow & Son, Coshocton, O., a 350-ton office building in Kansas City, a 300-ton pier shed for the Long Island railroad, the Clark department store building at Birmingham, 1,100 tons, a 1,000-ton building for the West Penn Steel Co., Tarentum, Pa., and on three San Francisco buildings aggregating 1,300 tons. Few new projects are developing in the East, though the outlook is promising. December bookings of the American Bridge Co., were about 30,000 tons, next to November the best month of the year. Milliken Bros. have taken 250 tons for the Duke residence in this city and 200 tons for a Coney Island theater. Other lines are unchanged. The New York cast iron pipe contract has not yet reached the foundries. Bar iron is quiet. We quote:

Angles, 3 to 6 inches x ¼-inch and heavier, 1.76c; beams, 3 to 15 inches, 1.76c; tees, 3 x ¼-inch and heavier, 1.81c; plates, carloads, tanks, 1.76c; marine boilers, 2.16c; bar iron, 1.46c to 1.56c; soft steel bars, 1.56c; sheets, No. 28, black, 2.66c.

Old Materials.—The continuance of conflicting views as to prices has rendered the market inactive, though a few brokers have bought rather heavily to cover short tonnages. Railroad lists are coming out and a quiet market is expected until they are placed. Consid-

erable accumulations are reported in the Albany-Troy district. We quote:

Old steel rails (re-rolling)	$15.50 to 16.00
Relaying rails	21.50 to 22.00
Old car wheels	14.00 to 14.50
Old iron car axles	20.00 to 21.00
Old steel car axles	19.50 to 20.50
Heavy melting steel	15.00 to 15.50
No. 1 railroad wrought	17.00 to 17.50
Iron track scrap	14.50 to 15.00
Wrought pipe	12.50 to 13.00
Cast borings	10.00 to 10.50
Wrought turnings	11.00 to 11.50
Heavy cast scrap	14.00 to 14.50
Railroad malleable	13.00 to 13.50
Stove plate	10.00 to 10.50
Grate bars	11.00 to 11.50

ST. LOUIS.

Pig Iron Prices Firm, but Very Little Buying is Being Done.

Jan. 5.

Pig Iron—The pig iron situation in the St. Louis territory in regard to prices is one of firmness, $13 for No. 2, Birmingham, being the lowest quotation reported. Not much buying was done last week, although it is believed that a general buying movement will begin soon. Several firms report inquiries out for carload and 100-ton lots, and one firm had an inquiry in today's mail for 500 tons of No. 2. Nearly all of the inquiries are for delivery over the first quarter and half of 1909. Our quotations, delivered, to which the freight of $3.75 from Birmingham has been added, are firm as follows:

No. 1 southern	$17.25 to 17.75
No. 2 southern	16.75 to 17.25
No. 3 southern	16.25 to 16.75
No. 4 southern	15.75 to 16.25

Coke—The coke market is unchanged since last report. The best selected 72-hour Connellsville foundry coke is held at $2.25 to $2.75, and the best selected 48-hour furnace grades at $1.80 to $2.25, all f. o. b. ovens, and for immediate and future shipments. Virginia and West Virginia 72-hour foundry coke is firm at $2.50 to $2.75 ovens, for shipment over the first half of 1909, and at $2.75 for shipment over the second half. Virginia furnace coke is quoted at $2 to $2.25, ovens. The freight to East St. Louis and St. Louis is $2.80, and $2.70 on Virginia coke when shipment is destined beyond St. Louis.

Old Material.—The scrap iron market is firm as follows:

Cast iron borings, free from foreign material, net tons	$ 6.00
Steel axle turnings, gross tons	12.25
Steel railroad axles, net ton	17.50 to 18.50
Iron railroad axles, net ton	19.00 to 20.00
Miscellaneous steel scrap, gross ton	12.25
Old car wheels, gross ton	16.00
No. 1 railroad cast scrap, net ton	12.00 to 12.50
Heavy machinery cast, net ton	13.00
Stove plate and light cast, net ton	11.50
Sheet iron, net tons, uncut	5.00
No. 1 railroad wrought, net ton	12.00 to 13.00
Railroad malleable, net ton	11.50
Heavy melting steel, net ton	11.50 to 12.00
Relaying rails, net ton	14.00 to 15.00

BIRMINGHAM, ALA.

Some Buying of Pig Iron and Prices Are Tending Upward.

Jan. 4.

Some little iron buying is reported in the Birmingham district and the expectations are that before the end of this week, or surely by the first of the coming week, there will be considerable activity noted. One of the smaller iron companies of the district reported the sale during the past week, before the holiday season was over, of a few hundred tons of gray forge iron on a basis of $13 per ton, No. 2 foundry, delivery to be made in January. The larger companies are said to be receiving scattering orders for iron, delivery during the first three months of the year. When the buying commences, it will be for the second quarter, as the probable make for the months of January, February and March has been nicely covered. In some quarters, $13.50 per ton, No. 2 foundry, is being sounded, but the general business is still being placed at $13 per ton. Inquiries are now coming in at a lively rate.

Reports which are received in Birmingham indicate that there was but little time lost at the furnaces during the holiday season and the production was disturbed but little.

A feature of the conditions in the Birmingham district is the announcement that the reorganization of the Southern Steel Co. (bankrupt) is about to be realized, the needed capital being underwritten now in the east.

BRITISH IRON MARKET.

More Inquiries for Pig Iron—American Cheerfulness Helps.

Office of THE IRON TRADE REVIEW,
Prince's Chambers, Corporation St.,
Birmingham, Eng., Dec. 24.

Naturally, pig iron business is tapering off at the end of the year. Yet the business done at Cleveland during the past week has been rather heavier than usual. There have been more inquiries over the next half year, and in some cases makers have booked No. 3 until June at 49s 6d ($12.12), although some others quote a higher figure. Better reports from Germany are having a good effect, and the continued cheerfulness of American cables is assisting the buying movement. Selling prices today are 49s 1d ($12.2) with 49s 8d ($12.16) three months, for No. 3. The comparatively small shipments continue to favor additions to stocks, Connal's stores showing a total of 123,152 tons. The slightly better demand for steel is assisting hematite, but these brands are not at present attractive. Cleveland hematite now makes 56s 6d ($13.82). The west coast continues to be rather badly off with the majority of its furnaces out of blast. In the Cumberland district, out of 44 furnaces there are only 18 in operation. This constitutes a record, the previous lowest being 20. The great dullness of ship building is mainly responsible for the poor demand for steel bars and sections. The rail trade is slightly improving. In the Midlands there is a good deal of pig iron business still being done with a slight upward tendency in prices. The furnaces are all well off for work, and are inclined to make advances in the new year.

METAL MARKET

NEW YORK.

Jan. 5.

Copper.—A moderate but fairly active buying movement has sent prices up slightly and has maintained them on the basis of 14⅜c to 14⅝c for Lake; 14⅛c to 14¼c for electrolytic; and 13⅞c to 14⅛c for casting.

Pig Tin.—Spot and early delivery metal is ranging between 29c and 29¼c, and the situation is fairly strong, reflecting conditions abroad.

Pig Lead.—An advance on Monday sent prices to 4.17½c to 4.22½c, New York, and lead is in good demand with a strong undertone.

Spelter.—Light offering has resulted in a slight advance to 5.12½c to 5.17½c, New York.

Antimony.—Cookson's, 8.15c to 8.25c; Hallett's, 8c to 8.10c; ordinary brands, 7.75c to 7.87c.

CHICAGO.

Jan. 5.

The movement in metals has been very quiet during the week. Tin is slightly weaker. We quote as follows.

Lake copper, carload lots, 14¾c to 15c; castings, carload lots, 14½c; pig tin, 31¼c to 31½c; spelter, 5.25c to 5.50c; pig lead, desilverized, 4.40 to 4.45c in 50-ton lots; corroding, 4.85c to 4.95c in 50-ton lots; car lots, 2½c per 100 pounds higher; sheet zinc, 7c list, f. o. b. LaSalle in car lots of 600-pound flasks; Cookson's antimony, 10½c to 11c; other grades, 10c.

There were no changes in the old metal prices during the week and we continue to quote to dealers as follows:

Copper wire, 12¼c; heavy copper, 12¾c; light copper, 11½c; heavy red brass, 11¾c; heavy yellow brass, 8¾c; light brass, 6¾c; No. 1 red brass bor-

ings, 9¼c; No. 1 yellow brass borings, 9¼c; brass clippings, 8¾c; tea lead, 3¼c; lead scrap, 3¾c; zinc, 3.25c; tin plate, 24c; tin foil, 23c; pewter, 16c; electrotype plates, free from wood, 4c; electrotype dross, 2¾c; stereotype plates, 4¼c; stereotype dross, 3c; prime slab zinc dross, $55 per ton.

ST. LOUIS.

Jan. 4.

Lead and Zinc.—Zinc ore in the Missouri-Kansas district sold at $40 to $41 base during the first week in 1909, and lower grades brought as high as $45 base. The top price paid for lead was $50.50, the bulk of the ore selling for $50 a ton. Quite a number of the largest lead producers are holding their ore with the expectation of receiving still higher figures.

The same conditions are predicted for zinc, and if they are realized there will be a general cleaning out of bins over the entire district. Very few of the large producers are idle, and developments are making for a record-breaking output of ore during the present year.

There is a sameness in the metal markets, St. Louis lead being dull at $4 and spelter at $5.05. Lead in New York is quoted at $4.15 and spelter at $5.15. The highest price quoted for silicate of zinc was $21.50.

DEATH OF JOSHUA RHODES.

Joshua Rhodes, a pioneer business man of Pittsburg, and for years a prominent figure in the iron and steel industry, died at his home in that city, Jan. 5, at the age of 84 years. He had been in failing health for the past 18 months, but, while retired from active business, had devoted his attention to commercial affairs as a director of several interests, up to the very end. His death was due to natural infirmities.

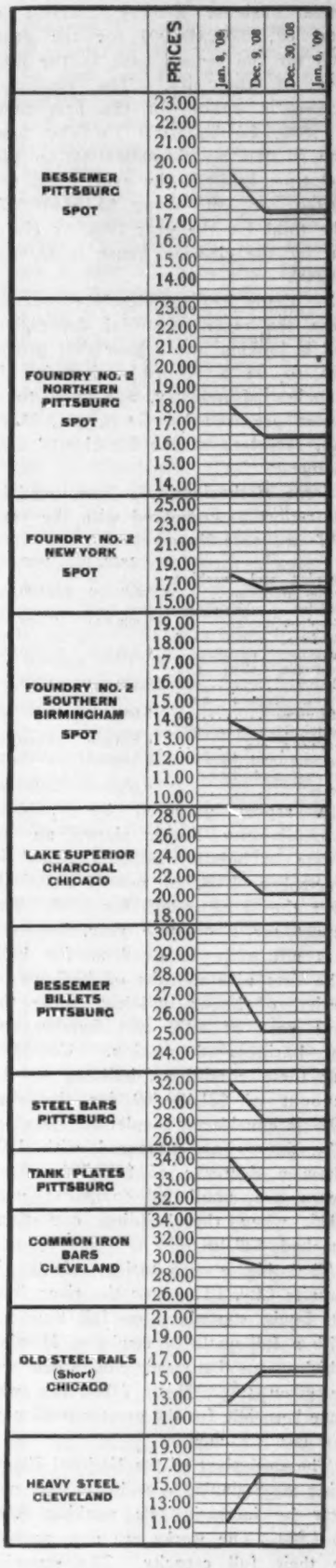
Mr. Rhodes was born in London, March 19, 1824. The family emigrated to the United States in 1830, and settled at Albany and Buffalo, N. Y. Two years later, Pittsburg was made the home of the family and it has been so ever since. At the death of his father, when he was but 12 years of age, Mr. Rhodes began business life as a clerk in a grocery store. His perseverance and energy made him a proprietor at 20. The great Pittsburg fire in 1845 swept away his little store, but undaunted the young man turned his attention to other lines. His versatility as a business man is emphasized in that in turn he became confectioner, baker, coal operator and manufacturer.

His entry into the iron and steel industry was about 25 years ago when he first leased and afterwards bought a pipe mill on Herrs Island, Pittsburg, forming a company capitalized at $1,200,000. A short time later he acquired possession of the Crescent Tool Co.'s plant in Pittsburg, converted it into a tube mill and changed its name to the Pennsylvania Tube Works. Mr. Rhodes acted as the president of this enterprse and by aggressive as well as conservative methods built up an extensive business until, when the plant was absorbed by the National Tube Co., it became one of the principal mills of that corporation. Mr. Rhodes was made chairman of the executive board of the National Tube Co., and served some time in that capacity. His other iron and steel ventures included his participation as an organizer of the Apollo Iron & Steel Co., and a heavy stockholder of the American Sheet Steel Co. He was also largely interested in banking, traction and bridge corporations. He leaves a widow, one son and two daughters. Another son, Joshua W. Rhodes, who had organized the Cherry Valley Iron Co., and was active in the development of iron ore resources, died June 30, 1908.

Two New Open-Hearths.—The Bollinger-Andrews Construction Co., Pittsburg, has taken the contract for the enlargement of the open-hearth department of the Allegheny Steel Co. at Brackenridge, Pa. The building will be 75 x 280 feet in dimensions, of heavy mill construction and will provide space for the installation of two additional open-hearth furnaces which will give the company a capacity of six open-hearths. The work will be completed about March 1. Approximately 1,000 tons of steel will be required for the improvement.

Foremen's Club.—At the next meeting of the Metal Trades Superintendents' and Foremen's Club of Cleveland several of the members will read papers on the "Premium System" and the "Piece System," after which a general discussion will be had. The club holds a meeting the second Saturday of each month and is always looking for speakers who can give practical talks on subjects of interest to metal manufacturers. A hearty welcome is extended to shop men from other cities who will volunteer to speak. Phillip Frankel, 310 New England building, is secretary of the club.

PRICE CHART.



RESUMPTION OF ACTIVITY AT ST. LOUIS.

Measured by its bank clearings, St. Louis business activity reached a total of $3,000,000,000 for the year 1908 for the second time in the history of the city. The clearings reached a billion for the first time in 1890; $2,000,000,000 for the first time in 1901, and $3,000,000,000 for the first time in 1907, the exact total reported for 1907 being $3,165,619,327. The total for the year 1908, as given out by the clearing house is $3,065,000,000.

St. Louis has completely recovered from the recent financial depression and is looking into a year that promises to be a record-breaker in all branches of industry, according to a report prepared by George H. Morgan, secretary of the Merchants' Exchange.

Some of the industries mentioned in the report as compared with the year 1907 are as follows:

	1908.	1907.
Foundry and machine shop products	$15,000,000	$25,000,000
Vehicles, agricultural implements, etc.	15,000,000	23,000,000
Plumbers, steam and gasfitters' supplies	9,000,000	10,000,000
Hardware, shelf and heavy	37,000,000	45,000,000
Stoves, ranges and furnaces	5,000,000	10,000,000
Electrical supply machinery, etc.	9,500,000	13,000,000
Saddlery and harness.	3,350,000	4,000,000
Railway and street cars	9,000,000	34,000,000

A report prepared by Building Commissioner Smith shows an increase in building permits issued in December, 1908, of nearly $1,000,000 over the same month for 1907. The report for the whole year, however, was not quite so good as for 1907. The first nine months of 1907 was a period of heavy building, while the first part of 1908 was handicapped by business depression. Considering these conditions, building to the amount of $21,190,369 for the year 1908 is considered a splendid showing. The figures as compared with 1907 show a decrease of $702,768. Both years are small as compared with 1906, when the building operations reached $29,938,693.

The big manufacturing plants in Granite City, Ill., across the river from St. Louis, started up on full time and with a full quota of employes, Monday, which means that steady employment will be given to 2,000 to 3,000 men who have been idle for the greater portion of the last six months.

The steel plant of the National Enameling & Stamping Co. began the new year by increasing its working force to 1,800. The works are now running to their full capacity. The stamping plant of the same concern, which has been idle for some time, will reopen Wednesday with 1,200 or 1,300 men at work.

The Helmbacher rolling mills at Madison, Ill., will make large additions to its working force on Feb. 1.

William J. Lynch, superintendent of the National Enameling & Stamping Co. at Granite City, says the industrial prospects for Granite City for 1909 are very bright. Since the steel works opened up a few months ago, he says, with a small force of workmen, orders have been pouring in, until now when the company finds it necessary to increase its working force to 1,800 men, the full quota. Mr. Lynch says the company has orders enough ahead to keep the plant running full capacity for many months, and orders enough in prospect to keep the plant going a full year. He predicts a prosperous year for the company and its employes.

DAVID G. KERR.

THE NEW SECOND VICE PRESIDENT.

David G. Kerr, of Pittsburg, the newly elected second vice president of the United States Steel Corporation, has spent his entire career in the iron and steel industry in the service of the Carnegie Steel Co. Immediately following his graduation with high honors from Lehigh University in 1884, he entered the employment of that company in a minor capacity. He was attached to the Edgar Thomson steel works and by a series of rapid promotions was finally made superintendent of the blast furnace department, succeeding James Gayley, who had taken charge of the ore and limestone interests of the company. In 1901, he entered the office of Mr. Gayley, and when the latter was elected first vice president of the United States Steel Corporation, he succeeded to the position of ore agent of the Carnegie Steel Co. His duties in this capacity consisted of directing the distribution of the ore, limestone and coke from their source to the blast furnaces. At the present time he is president of the Pennsylvania & Lake Erie Dock Co., president of the Columbus Stone Co., president of the Mahoning Limestone Co., vice president of the Pittsburg & Conneaut Dock Co., secretary of the Pittsburg Limestone Co., Ltd., secretary of the Isabella Limestone Co., and secretary and treasurer of the People's Supply Co., Ltd., all subsidiaries of the Carnegie Steel Co. In addition, he is interested officially in the Pittsburg, Bessemer & Lake Erie Railroad Co.

It is an interesting fact that Mr. Kerr in his advancement succeeded Mr. Gayley to practically all the important offices which the latter had held in the service of the Carnegie Steel Co. and the United States Steel Corporation.

LEAD AND ZINC STATISTICS.

The combined valuation of lead and zinc ores mined and sold in the Missouri-Kansas lead and zinc mining district during the year 1908 was $11,119,216, or $4,300,611 short of the valuation for 1907. The decrease was due to the loss to operators because of the financial depression and the consequent retarding effect upon development and prospect work in the various camps.

The prices for the year 1908 as a whole were well up to the average for the years preceding 1907, when quotations of both ores reached the highest mark ever made.

The average price for zinc ore for 1908, including high and low grades, was approximately $33 a ton, while the average price paid on the best grades was $40.13 a ton. The extreme high and low prices for the year were $47 and $36.50, the higher price having been paid toward the close of the year, following the movement on the part of producers to secure protection from the national government against importation of minerals from Mexico.

The price of lead ore did not at any time during the year reach the high mark of 1907, but was by no means unsatisfactory. The extreme high price was $66, as compared with $88 for

1907. The extreme low price was $45 for the best grades. The average price for best grades of lead ore for the year was $55.64 a ton.

REORGANIZATION OF NEW YORK STATE STEEL CO.

The New York State Steel Co., of Buffalo, has passed out of the receivership, the interest on its mortgage being paid Jan. 2, and the receivers discharged the same date. The control of the reorganized company will be in the hands of capitalists outside of Buffalo. On Jan. 12, the annual meeting will be held and a new directorate elected. The company was capitalized at $3,000,000 and $1,000,000 of new preferred stock has been issued of which 10 per cent has been paid in. It is planned to make improvements on the property and the first work will be the completion of an unfinished blast furnace. This contract will take about two months to complete. The company will continue the manufacture of billets, blooms and slabs.

Will Issue New Bonds.—The St. Louis Car Co. has filed a deed of trust with the Recorder of Deeds in St. Louis for $2,500,000, covering all of its real and personal property. The deed is in favor of the Commonwealth Trust Co., of St. Louis, trustee for William B. Phelps, one of the employes of the car company. George J. Kobusch, president of the car company, says the filing of the deed is the first step toward the formal rebonding of the company. The company is capitalized at $3,000,000, and has $1,000,000 of bonds outstanding. The $1,000,000 of bonds will be taken up and $2,500,000 of new bonds will be issued. This will give the company $1,500,000 of new capital.

The Johnson & Jennings Co., Cleveland, iron founder, machinist and chemical specialist, announces that it has taken over the business of the American Mine & Mfg. Co., also of Cleveland, and will continue the American company's business in connection with its own under the style of the Johnson & Jennings Co.

By a decree of the New Jersey court of chancery, on a petition of the receivers, the Pope Mfg. Co. was dissolved, the receivers showing that assets had been disposed of and asking the order to dissolve in order to protect stockholders from assessment of the state corporation tax on the charter.

PERSONALS.

Samuel T. Nicholson has been elected president and general manager of the Vulcan Iron Works, Wilkesbarre, Pa., succeeding the late President E. H. Jones.

Arthur L. Stevens, well known industrial and furnace engineer, on Jan. 1 became associated with the Rockwell Furnace Co., 26 Cortlandt street, New York City.

George Brown, formerly assistant superintendent, has been appointed superintendent of the Carnegie Steel Co.'s furnaces at New Castle, Pa., vice John C. Seawright, resigned.

H. T. Herr has assumed the duties of general manager of the Westinghouse Machine Co., East Pittsburg, Pa. Mr. Herr is a brother of E. M. Herr, vice president and general manager of the Westinghouse Electric & Mfg. Co.

Charles Griffith Robinson, for 12 years assistant superintendent of the Pennsylvania Steel Co., now the American Steel Foundries, has been appointed superintendent of the foundry of the Chicago Steel Foundry Co.

J. G. Rohrman, who has been associated with the Pittsburg office of the Youngstown Sheet & Tube Co., has been made assistant sales manager of the company in the Pittsburg territory and will devote particular attention to the trade in wire nails and wire products.

E. W. Pargny is now serving in the capacity of president of the American Sheet & Tin Plate Co., having succeeded C. W. Bray resigned, to that position Jan. 1. Other changes among the officials of the company which have gone into effect include the elevation of S. A. Davis, second vice president, to first vice president and J. I. Andrews, assistant general manager of sales, to general manager of sales. Walter C. Carroll, assistant district manager at St. Louis and Fred M. Fuller have been made assistant general managers of sales. C. W. Bennett, assistant to the president, continues in this position with increased duties.

OBITUARIES.

David Tyler, foundryman, died unexpectedly of heart trouble at his home in Millville, Pa., Dec. 26.

George A. Johnston, vice president of the Sligo Iron Store Co., St. Louis, died at the Berlin hotel in that city Jan. 2, after an illness of two days. He had been in failing health for quite a number of months, but continued at his business up to two days before his death. He was a native of St. Louis, and had been connected with the Sligo Iron Store Co. for more than 30 years. For several years he had resided in Alton, Ill.

Chauncey F. Perkins, general ore and coal agent of the Pennsylvania lines west, died Jan. 3 at Philadelphia, aged 56 years. Mr. Perkins had been in ill health for some time, and was given a leave of absence from his duties about a year ago.

Charles Tinker, founder of the industries now including the Ashtabula and Geneva, O., plants of the American Fork & Hoe Co., died Dec. 27 at his home in Ashtabula, aged 87 years. He founded the Geneva plant in 1870, and the Ashtabula plant, of which he was first president, 10 years later.

Achille Lucienne Archambault, an inventor and the founder of the Kensington Iron Works, Chicago, died at his home in Philadelphia, Dec. 28. He is credited with having invented the first portable engine used in this country, and also with having designed the first steam yacht sailing American waters.

Anson R. Flower died Jan. 3 at his summer home in Watertown, N. Y., after an illness of eight weeks. He took a leading part in the organization of the Federal Steel Co., and later, the United States Steel Corporation. He was at one time president of the Amalgamated Copper Co., of which he was a director at the time of his death. He was born at Theresa, N. Y., in 1843.

Eliakim T. Robb died Dec. 31 at his home at Chester, Pa., aged 77 years. For a number of years he was in the drafting department of the Vulcan works, later with Reaney Son & Archbold, afterward Roach's ship yards. In later years, he was associated with various manufacturing plants at Chester. He prepared the plans for the Penn Steel Castings Co.'s plant and was secretary and designer for the Vulcan works, Chester.

Charles H. Besly, founder of the firm of Chas. H. Besly & Co., Chicago, and also of the firm of the same name at Beloit, Wis., died Dec. 31 at the Henrotin Memorial Hospital, Chicago. The funeral was held from his Chicago residence on Jan. 2. Mr. Besly was born in Milwaukee, June 16, 1852, and founded the companies which bear his name in 1876 and 1886, respectively. He had been a resident of Chicago since 1863 and was a member of the Chicago Athletic Association, the Union League Club, the Chicago Yacht Club and the Chicago Chamber of Commerce. He was also a member of the Engineers' Club and the Machinery Club, of New York City.

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SECOND DIRECTORY NUMBER.

When the first directory number of THE IRON TRADE REVIEW was issued Jan. 2, 1908, profound depression was still existing in the iron trade, although favorable indications were not lacking. The second directory number appears under much more encouraging conditions, as the clouds have broken, and while a great rush of business is not expected at an early date, the expressions contained in our market reviews and in letters from many men prominent in the business, are uniformly cheerful in looking forward toward steady improvement throughout the new year. On all hands there is a disposition to credit the movement inaugurated by Judge Gary with having accomplished a great deal in preventing ruinous competition, although some retired manufacturers do not appreciate the fact.

Development work on the Lake Superior iron ranges is covered very thoroughly and in an extremely interesting manner by our mining editor. In spite of the very heavy decrease in shipments, owners of Lake Superior mines have not been asleep, and preparations for future activity have been made. Recent work on the fossil iron ores of Georgia by Dr. S. W. McCallie has been unusually important, and is reviewed by Edwin C. Eckel, who has done much able work for the United States Geological Survey, with which he was connected for several years. An article on the iron ore deposits of the Pacific Northwest and a discussion of the possibilities of the development of the iron business in that section will be found of interest, as will also the paper on iron ores and iron production in Australia. The description of the Mountain Iron Club House represents an important phase of the efforts which are being made in the Lake Superior region to promote the social welfare of employes.

In manufacturing progress, probably the most notable achievement of the year is the putting in blast of the first furnaces of the Steel Corporation's new plant at Gary, Ind. A steel works of the magnitude of this one, designed from the ground up with all the resources and engineering skill of the Steel Corporation behind it, is bound to be of surpassing interest to the entire iron and steel world. We present in this issue the first of a series of articles describing in considerable detail this magnificent plant. The first installment deals with the general considerations governing the decision to erect a steel works of this magnitude and character at this particular location and also describes the blast furnace plant and its auxiliaries. Future installments will cover the different steel making and finishing departments, and will appear at short intervals during the next few months.

Another article, which will prove of interest and may be provocative of considerable discussion, is the one entitled "Steam vs. Gas-Electric Equipment for Steel Mills." The suggestion put forward by the author is a startling one, inasmuch as it provides for the scrapping of good and expensive steam equipment in mills, in order to replace it by gas-electric motive power. While, undoubtedly, many steel works managers will not agree with either the author's figures, or his conclusions, the argument seems to be based on sound reasoning and a field is open for discussion from which much may be learned.

The electric traveling crane has become an indispensable appliance in every factory, machine shop, mill and

PRINCIPLE OF STRIFE, THE OLD FOUNDATION, IS CRUMBLING.

BY WASHINGTON GLADDEN.

The newer righteousness is getting a foot-hold in the thoughts of men. It has got itself before the human mind as a possibility. That is enough. The rest is sure. Men are really beginning to consider it as the regulative principle of human society. They have never done that before. Never in my life-time has there been any room in the minds of practical men for the conception that the principle of good will could be trusted in the greater affairs of life. It is the principle of strife—modified and mitigated, of course, more or less by law and by compassion—but still regnant and all-controlling, that we have built our civilization upon. It is just now that we are beginning to question the adequacy of this foundation. It seems to be crumbling under our feet. And men are asking everywhere if there is not a better way. That inquiry will not be silenced. It will make itself heard in the factory, the counting room, the council chamber, the capitol. The logic of events will be working with it.

foundry, and we are pleased to offer an article discussing the conditions governing the design of this most useful tool. Another article worthy of careful consideration by metallurgical engineers in general is the one on the "Selection of Refractories." This is a carefully prepared compilation of the considerations which obtain in the lining of blast furnaces, open-hearths and other metallurgical furnaces. Not only are the best types of brick for various locations in the different furnaces pointed out, but explicit directions are given for using them. The article should have a wide application and prove of great use to all engineers and managers who have furnaces of any description under their care.

A YEAR OF PROMISE.

The year which has just opened is full of promise for the iron and steel trade. The present tonnage prospects would not have been considered favorable two years ago, but the viewpoint has been changed by a year of meager tonnage. Seen in the retrospect, the period of intense activity and constantly increasing tonnage, which began late in 1904 and lasted for practically three years, or until the end of October, 1907, now impresses the iron and steel trade as having been a period of unwonted and perhaps abnormal activity. If that is the correct view—and many have come to embrace it, the abnormality can be no more than that some wants of the public were anticipated when they could have been put off a year or two. No work was undertaken which will not ultimately be needed. No buildings were erected, no manufacturing plants built, no railroad laid, no cars bought, which will not in the near future prove absolutely necessary.

If there was some anticipation of the requirements in that period of extreme activity, the year just passed has taught a new lesson, for it has written practically no depreciation upon the work. In previous depressions, prices have so fallen as to cause widespread regret among those who had been too sanguine in providing for the future, that they had not waited and obtained the benefit of lower prices. In this depression, prices have declined so little that those who have bought iron and steel so heavily in the active period have seen scarcely any depreciation written upon the undertakings they carried through. Thus the feeling of unrest has not been engendered, and by this much at least industry is better off and in better position to resume the old-time activity.

The past year has been distinctly one of recuperation. Mere figures of total tonnage do not show the extent to which there has been recuperation, because many important tonnage operations were carried over from 1907, and gave to the forepart of 1908 an activity which could not have been maintained through the year without heavy accretions from other sources. Much railroad and other work has been financed and was being carried on when the financial panic occurred. It was carried to completion in the first half of 1908, and if financial conditions had remained bad, the year would have been one of almost steadily declining tonnage. A large part of the iron and steel output of the first half was against old work, while practically all of the second half was absolutely new business. The gain in new business, despite the completion of much old work in the first half, was sufficient to make the second half of 1908 show a gain of 2,000,000 tons in pig iron production as compared with the first half, production in the two halves being a trifle under 7,000,000 and 9,000,000 tons respectively.

While the total tonnage, some 16,000,000 tons in terms of pig iron, does not compare at all favorably with 1906 or 1907, each of which years showed more than 25,000,000 tons, the actual value of the 1908 output showed a much better ratio, as it ran much more to the more finely finished products. Production of rails and plates, for instance, fell off very heavily, while sheets, merchant pipe, wire products and tin plate came much nearer to holding their own. The production of tin plate showed a decline of less than 10 per cent from 1907.

These lighter lines maintained a steady improvement through the past year, and it would be unreasonable not to expect them to gain further in the year which has just been entered. The heavy lines, on the other hand, give excellent promise of gain on their part. They have gained but little thus far in actual tonnage output; the actual production of rails and shapes in the second half of 1908 was probably smaller than in the first half, and any gain they may now make will be a fresh accretion to the total tonnage of the industry.

The foreign balance of trade in iron and steel showed a gain in 1908 over 1907. The total exports declined, but not as much as the total imports. While exports fell off 345,000 gross tons, imports decreased by 455,000 tons showing an increase in the favorable balance of trade of 110,000 tons. This is certainly a most favorable showing, for in 1907 our exports were double our imports, and if both had fallen off *pro rata* to any considerable extent, there would have been a serious decrease in the balance of trade.

GREAT STRIDES MADE.

Comparing conditions now and one year ago, we have made great strides. On the evening of the day on which Taft was elected president, I was asked for a statement by our local paper here. I replied that I thought that within one year, everything would be running full. I meant by this that all the new plants, including the old ones, would be at work. I still adhere to this belief, although I was criticised by some of my friends for putting the time off so long. We must remember that every once in a while we overbuild producing plants, and then the country grows up to them, and all are needed and new ones are built. As ours is a tremendous country in area, and every other way, this will keep on like the brook—probably, forever.

There has been some halting recently on account of proposed tariff revision. I think it would have been wiser, before saying a word about the tariff, to have been content to get back into more normal condition. We could then have stood the strain better.

One of the important things which has happened during the past year is the co-operative movement, led by Judge Gary. This has been of incalculable benefit to the United States Steel Corporation, to the independent concerns, and more or less to the country generally.

J. G. Butler Jr.

Youngstown, O., Jan. 2.

As the latest official figures for foreign trade are those for November, issued last week, it is necessary to estimate December (at the November rate) but the December figures, when compiled, cannot materially change the estimates.

Our import and export trade in the past seven years is shown in the following table. The totals include scrap, pig iron, crude steel, rolled steel, structural work and fittings, nails, etc., but of course no machinery:

Iron and Steel Imports and Exports—Gross Tons.

	Imports.	Exports.
1902	1,212,839	372,398
1903	1,178,996	326,590
1904	266,398	1,167,710
1905	416,000	1,010,255
1906	577,809	1,325,740
1907	662,358	1,302,525
1908	207,776	957,323

The annual figures carry us back through the period of high pressure in 1902 and the early part of 1903 when there were heavy imports of pig iron and crude steel, with moderately large imports of some more finished products. In 1906 and 1907, the pressure did not invite such heavy imports. There was a moderately heavy import movement in pig iron and that was about all.

While export tonnage in 1908 fell off 26.5 per cent as compared with 1907, the proportion of our total product going abroad showed a very material increase. Adding, for a rough estimate, 10 per cent to the tonnage exported in order to arrive at a pig iron equivalent, we find the pig iron equivalent in 1907 as about 1,433,000 tons, and in 1908, 1,053,000 tons, so that in 1907 about 5.5 per cent of our pig iron went abroad, and in 1908, about 6.7 per cent.

Exports of hardware, tools, machinery, etc., did not hold up as well in 1908 as did the exports of the ordinary tonnage lines of iron and steel. The total value of all iron and steel exports, including the tonnage lines, together with machinery, hardware, etc., but not including agricultural machinery, was $150,000,000 in 1908, on the assumption that December exports showed no change from November. This compares with preceding years as follows:

Value of All Iron and Steel Exports.

1905	$142,930,513
1906	172,555,588
1907	197,036,781
1908	150,000,000

The drop shown is 23.8 per cent, in the total, which compares with a drop of 26.5 per cent in the tonnage lines, and this probably indicates that such lines as hardware, machinery, etc., decreased less than did the tonnage lines, as the tonnage lines probably suffered more in point of value than they did in point of tonnage.

DECREASE NOT SURPRISING

Railroad Track Laying Records for 1908 as to Equipment Show Falling Off.

To those who have been at all in touch with the railway situation, it is not surprising that the record of new main track laid down during the year just closing should show a substantial decrease; the surprising thing is the amount of mileage which was built, says the *Railroad Age-Gazette* in its summary for 1908. The record for 1908 shows 3,214 miles built, a decrease compared with 1907 of 1,998 miles, or 38.2 per cent. This record covers 39 states and territories of the United States which reported mileage and 11 which did not. The 1908 record is the smallest since 1904. Of the mileage laid in 1908, a total of 761 miles was laid east of the Mississippi, a decrease of about 59.6 per cent. West of the Mississippi the decrease was about 28.2 per cent, last year's record showing 2,455 miles built. In Canada there was a substantial increase of 21.7 per cent, there being built 1,248 miles in 1908. In Mexico there was an increase of 23.4 per cent. There is also included seven miles of track built by the Panama railroad.

During the past year, 35 car building companies in the United States and Canada built 78,771 cars, which is only 27 per cent of the number built in 1907. Of these cars built in the United States, 66,751 were freight cars for domestic service, and 1,206 for export; 1,566 passenger cars for domestic service and 71 for export. Canada built 8,593 freight cars for domestic service and five for export and 79 passenger cars for domestic service. Returns from 11 locomotive builders in the United States and Canada show a total of 2,342 engines, about the same relative falling off as in cars built. Of the 2,124 built in the United States 1,668 were for domestic service and 456 for export. The Canadian engines, 218, were all for domestic service. The orders placed for motive power and rolling stock by steam railroads in 1909 were smaller than in any year since the record of the *Railroad Age-Gazette* has been kept, only about 50 per cent of those placed in 1903. Commenting upon these figures, the *Age-Gazette* says:

"There is no doubt, however, that 'the corner has been turned.' The railways, after being almost out of the market for over a year, are once more shopping. One of the largest railway equipment manufacturing concerns in the United States tells us that it has received more inquiries during the past few weeks than in any equal time for many months. How good a year 1909 will be for either railways or makers of equipment, it would be futile to predict; but that it will be a good deal better year for them than 1908 can not be doubted. Despite the relatively small orders placed in 1908, they illustrate some tendencies that merit noting. All-steel cars for passenger equipment have passed the stage of experiment, and they are now being confidently ordered in large numbers. While steel coaches are being ordered by only a few roads, the use of steel underframes for baggage and mail cars has become more general. While a few large capacity steel freight cars have been built for special uses in and around steel works, the maximum capacity remains 50 tons, and this is not likely to be exceeded for some time to come. The 50-ton steel cars built for western lines are usually of the gondola type with drop bottom doors, as this form is available for lumber or other kinds of freight, in addition to the usual lading of coal or ore. Roller side bearings and center plates have at last demonstrated their advantages for large capacity cars, and they are now used in increasing numbers."

Crucible Extension.—The Vulcan Crucible Steel Co., Aliquippa, Pa., has begun work upon the erection of an extension 66 x 184 feet to its crucible department. The building will be of heavy mill construction provided with a crane runway, and when completed will make the main structure of the plant 300 feet in length. In enlarging its plant, the Vulcan Crucible Steel Co. is planning to bring its machinery into a more compact position. In the spring, a new set of 16-inch rolls will be installed and the hammer department rearranged. All the contracts for the improvement have been awarded, the Pittsburg Bridge & Iron Works doing the erecting work. The foundations are now in and the extension is expected to be completed within five weeks.

BAD YEAR

FOR SYNDICATES IN THE GERMAN EMPIRE.

Large Importations of English Pig Iron Result From High German Prices — Unsatisfactory Conditions in Finished Lines.

Dusseldorf, Dec. 18, 1908.—The conditions on the iron and steel market prevailing here, at the beginning of the year 1908 were discouraging in every respect. An official bankrate of 7½ per cent, which our money market had never seen before, kept the whole business life under a severe pressure. Nevertheless the demand for money from all concerns, from the state, the towns, the provinces and from the industry was very urgent and could only be satisfied at increased interests. In consequence of this dear and scarce money, the building business was almost dead during 1908. It is true that the greater part of our iron and steel works in the beginning of 1908 had still material to deliver on contracts, made in 1907 at high prices, but the increased production in all lines of the trade exceeded the demand very soon; thus growing stocks were unavoidable. Especially in pig iron the situation has been quite unhealthy. At its beginning, the price for best Westfalian hematite was 82 marks per 1,000 kilos ($19.50). This unnatural price was kept unaltered by the pig iron syndicate till September, 1908. The consequence of these unnaturally high inland prices for pig iron was that very great quantities of all sorts of English pig iron were imported, whilst our own makers, being unable to make any reduction without the authority of the syndicate, had to bank their whole production. The import of English pig iron into Germany has never been so great as in 1908 and, on the other hand, the pig iron stocks at our own blast furnaces have never been so high. At the date when the pig iron syndicate was dissolved, i. e., on Oct. 1, the stocks of pig iron amounted to about 500,000 tons. They would have been still greater, but the production had been kept as small as possible while getting the necessary blast furnace gas for driving the machines in the steel works, rolling mills, foundries, etc., attached to the blast furnaces. Owing to the decreased pig iron production, stocks of coke increased enormously and they are reliably said to be still about 3,000,000 tons. The late pig iron syndicate was to hold good until Oct. 1, 1908. Its last act was a reduction of the pig iron prices of about 5 to 7 marks per ton ($1.20 to $1.75), but these reductions came far too late and besides were quite insufficient to improve the demand. English hematite at the time of these reductions in September was about 60 shillings f. o. b. English port, i. e., still one to two marks (25 to 50 cents) per ton below the price for Westfalian hematite. This unnatural state of things was stopped in October by the dissolution of the pig iron syndicate and all its branches. Immediately after the dissolution, the pig iron prices went down rapidly and contracts were made for delivery after Jan. 1, 1909, at as low as 51 marks per 1,000 kilos ($12.15). Thus the difference in the prices for pig iron has become as great as about 31 marks per 1,000 kilograms ($7.35), if the maximum and minimum prices are to be compared. The above bottom prices have tempted the buyers of pig iron, and consumers have covered for their requirements till the middle of 1909, some of them even till the end of 1909. However, it is feared that far more has been bought than the legitimate demand calls for.

Deplorable Conditions.

In half finished material, the situation has been deplorable during the whole year. The prices were kept high by the Stahlwerksverband for the inland, so that the not-mixed rolling mills were unable to stand the competition of the big mixed works. Consequently, the not-mixed works had to close their plants. This fact caused, of course, a heavy decrease of the demand for half finished products. To keep works going, the export business was forced at any price. Billets for wire making have been delivered at 80 marks per 1,000 kilos delivered Manchester ($19), whilst the inland price was as high as 100 marks per ton ($23.75).

Also in rails and other railway material, the quantity of orders was very limited. The state railways ordered a much smaller quantity than in the previous years and for export, the Russian competition was very keen. The monthly reports of the Stahlwerksverband show a decline every month, which even now continues.

Bar Iron and Plates.

The very worst part of the whole market was bar iron and plates. These two products, being the only ones which were not syndicated, but sold in free competition, had to suffer most heavily. In consequence of the small quantity of orders they got from the Stahlwerksverband for half finished and railway material, they had to use these two products for finding an outlet for the excess of their production. The prices were and are still most irregular. The average price for bar iron of a good commercial quality was 100 marks ($24) per ton f. o. b. producer's works, but for export even 90 marks ($24.40) f. o. b. Rotterdam-Antwerp was taken. In sheets nearly the whole production was exported at ruinous prices.

If the past year was a poor one in every respect, it has had one good result: It has shown that the syndicate system is not satisfactory for the German market. It has shown that there must be either a trust, which comprises all iron and steel products and all works, or that, if a trust is impossible, free competition is far better. With the very different interests of the different industrial centers here, a trust will be impossible and as the syndicate system has been given a strong knock by the collapse of the very important pig iron syndicate, we are likely to get free competition.

The prospects for the coming year seem to be better; in any case, we are at the bottom and there is only a possibility of an improvement.

Thomas Steel Co. Organizes.—Feb 1, The Niles Iron & Steel Co. and The Niles Corrugating Co., both of Niles, O., will be taken over by The Thomas Steel Co., recently incorporated, with a capital stock of $500,000. Large additions to both plants are planned, which will make the new company one of the strongest in its line. A full and complete line of galvanized sheets, corrugated roofings, sheet steel, eave trough and conductor pipe will be manufactured. The management of The Thomas Steel Co. will be in the hands of the following: W. A. Thomas, president, C. G. Thomas, vice-president and treasurer, and C. R. Thomas, secretary.

The Union Steam Boiler Works, at State and Center streets, Columbus, J. J. Borger, proprietor, was badly damaged by fire Jan. 5, the loss being placed at about $10,000, partially insured.

Pig Iron Production for 1908

The blast furnace returns for December show a total production during that month of 1,722,557 tons of coke and anthracite pig iron, spiegel and ferro, an increase over November of 140,243 tons. The increase over November is 8.8 per cent. The December production is divided as follows: Steel making irons, 1,101,284, an increase of 111,824 tons, or 11.2 per cent; merchant iron, 613,143 tons, an increase of 34,355 tons, or 5.9 per cent; spiegel and ferro amounted to 8,130 tons, a decrease of 5,936 tons.

This gives a total production for the year of 15,679,033 tons, compared with 25,299,732 tons for 1907, a decrease for the year 1908 of 9,620,699 tons, or 37.7 per cent. Production for the first half of 1908 was 6,789,463 tons, and for the second half 8,889,570 tons. The second half production increased over the first half by 1,100,107 tons, or 16.2 per cent. The increase in production during December over January is 679,183 tons, or 65.1 per cent.

The production by months shows an almost uniform improvement since June, when it was 1,106,300 tons, this being the low point of a slight reaction which set in after March, which was the high point between January and June, the January production representing the lowest point reached during the depression.

	1908	1907
January	1,043,374	2,194,801
February	1,086,809	2,047,036
March	1,229,856	2,216,709
April	1,155,122	2,226,708
May	1,168,002	2,291,030
June	1,106,300	2,237,420
July	1,228,604	2,253,243
August	1,366,019	2,243,656
September	1,416,252	2,174,148
October	1,573,824	2,359,690
November	1,582,314	1,820,558
December	1,722,557	1,234,733
Total	15,679,033	25,299,732

Taking up the December figures in detail, every state showed an increase, excepting Virginia. In nearly every case there was an increase in both steel making and merchant iron. Ohio showed the greatest increase, both in point of tonnage and percentage of increase. The increase in production in Pennsylvania was, approximately, 37,000 tons, or 5.3 per cent, divided between 35,000 tons of steel making iron and 2,000 tons of merchant iron. Ohio increased its production 72,711 tons, divided, approximately, into 24,000 tons of merchant iron and 49,000 tons of steel making iron. The percentage increase in Ohio was 25. Alabama increased its production 5,584 tons, or 4 per cent, divided almost equally between steel making and merchant iron.

Virginia's production dropped from 30,647 to 22,234 tons, a decrease of 8,413 tons, or 27.5 per cent. New York showed an increase of 11.6 per cent, or 14,109 tons, of which, approximately, 2,500 tons were merchant and 11,500 tons were steel-making iron. New Jersey's production increased 13.7 per cent, being 2,207 tons merchant iron. Illinois had an increase of 9.5 per cent, represented by 13,643 tons, of which, approximately, 1,200 tons were merchant iron and 11,400 steel-making iron. The Tennessee group had an increase in production of 3,713 tons, or 9 per cent, of which 800 tons, approximately, were merchant iron and 2,900 tons steel-making iron. The Maryland group showed a decrease of 700 tons in steel-making iron and a gain of approximately 4,100 tons of merchant iron, the total increase being 3,427 tons, or 5.1 per cent. The Georgia group increased its production 2,911 tons, all merchant iron, the percentage increase being 14.

The number of stacks in the country has been increased by one by the blowing in of No. 12 stack at Gary, Ind., making the total number 403. The number of active stacks during December increased by nine, five of these being in Pennsylvania, two in Ohio, one in New Jersey, one in Kentucky, one in Indiana, and one in Michigan. There is one less stack in blast in both Tennessee and Virginia. The percentage of active capacity in blast throughout the country has increased to 55.6 per cent from 51.1 in November. The greatest increase is in Ohio, where the percentage is 60.5, compared to 49.1.

The average daily production during the month was 55,566 tons, compared with 52,744 tons in November, or an increase of 10.5 per cent. The daily production shows an average during the various months of the year, as follows:

January	34,316
February	37,476
March	39,672
April	38,504
May	37,677
June	36,876
July	39,632
August	44,065
September	47,208
October	50,764
November	52,744
December	55,566

A Correction.—Reports of the accident which occurred at the plant of the Tennessee Coal, Iron & Railroad Co., at Ensley, Dec. 28, were much exaggerated. Only two laborers were killed and two injured in an excavation for a pump house, owing to a part of one of the sides caving in, not ten laborers as stated in our issue of Dec. 31.

DECEMBER FURNACE REPORT.

STATES—	NO. OF STACKS.	NO. IN BLAST ON LAST DAY OF MONTH. DEC.	NO. IN BLAST ON LAST DAY OF MONTH. NOV.	PERCENTAGE OF TOTAL POSSIBLE OUTPUT MADE.	AV. DAILY CAPACITY IN BLAST LAST DAY OF MONTH.	ACTUAL TONNAGE MAKE. MERCHANT.	ACTUAL TONNAGE MAKE. NON-MERCHANT.	TOTALS. DEC.	TOTALS. NOV.
Pennsylvania	153	89	84	54.3	25,729.9	165,073	573,663	738,736	701,431
Ohio	65	39	37	60.5	11,715.6	129,022	230,214	359,236	286,525
Alabama	46	23	23	49.7	210.8	119,802	27,001	146,803	141,219
Virginia	24	10	11	43.0	740.0	22,234	———	22,234	30,647
New York	25	15	15	60.0	4,359.0	63,280	71,848	135,128	121,237
New Jersey	9	3	2	27.9	718.5	18,680	———	18,680	16,273
Illinois	25	14	14	56.0	5,014.8	17,541	137,921	155,462	142,819
Tennessee	18	10	11						
West Virginia	4	1	1	45.8	1,415.7	37,367	7,400	44,767	41,054
Kentucky	7	2	1						
Maryland	4	2	2						
Wisconsin	6	3	3	51.8	2,418.0	16,649	53,237	69,886	66,459
Colorado	6	3	3						
Indiana	2	2	1						
Georgia	2	1	1						
Texas	3	0	0						
Minnesota	1	1	1	50.2	839.0	23,495	———	23,495	20,584
Michigan	2	2	1						
Missouri	1	1	1						
Spiegel—All states								3,096	10,727
Ferro—All states								5,034	3,339
Totals	403	221	212	55.6	53,161.3	613,143	1,101,284	1,722,557	1,582,314

MUCH WORK DONE DURING A DULL YEAR

EXTENSIVE STRIPPING OPERATIONS AT MESABI RANGE MINES

Creditable Achievements Include Sinking of Concrete Shafts—Many Millions of Tons of Overburden Removed—Outlook Favorable for Forty Million Ton Output Next Year

By Oliver J. Abell.

The atmosphere of record breaking brings out unusual performances on every hand, but the years of industrial depression develop only such expansion as is conservatively safe and sound. While we can see but few of the spectacular achievements of 1907 repeated in 1908, there may be found in the ore mining operations of the past year much to cause satisfaction, including some very creditable accomplishments. The production of ore in the nature of things anticipates consumption and as a result the sudden shrinkage of demand since October, 1907, immediately following the tremendous shipments intended to provide for that period, brought down upon the ore mines, more severely than upon any other branch of the industry, the necessity for rigid curtailment. Many miners had to be laid off and the mining towns suffered accordingly, but the manner in which men with dependent families were provided for and the comparatively slight extent to which wages were reduced are worthy of mention and commendation. On the other hand, labor troubles were, of course, entirely absent except for a brief strike on the Allouez docks, and the efficiency of labor was materially increased. In connection with the general iron and steel market, merchant iron ore became the keystone of the now notable policy of price maintenance. This situation resulted because of the relation of ore prices to pig iron prices and thence to the price of finished steel. Despite the extreme contrast in the ore situation of 1907 and 1908 the price of ore was maintained well into midsummer, when the defection of one interest resulted in a general reduction of 50 cents a ton. It is fair to say that the position of the Steel Corporation in this matter may not be attributed entirely to the peculiar relation it holds with regard to ore supply and the market, for the independent ore interests also looked with favor upon the conservation of their resources until a commensurate price could be obtained. Also noteworthy with respect to the sale of ore was the new basis of penalties established during the year. This resulted from the increasing content of other material than iron oxide in the ores and placed an excess penalty on ores containing less than 50 per cent iron and provided a premium for ores in which the iron content exceeded 55 per cent. The object of the new basis was to relieve the furnaces of the additional cost of handling increased gangue in the ores low in iron, which extra cost was not provided for when the price was determined on a uniform scale regardless of the proportions of iron, phosphorus, moisture and gangue.

The Shipment Figures.

What has been done in the development of mines and the shipment of ore during 1908 followed closely the program predicted. The story of the 12 months as compared with the preceding year is briefly told in the contrast of shipment figures. The total lake shipment for 1908 was 25,420,752 tons as against 41,288,755 tons in 1907. This shows a general production in 1908 of practically 60 per cent of the year before and it represents quite accurately the average situation. The same relation applies to the shipments of the Steel Corporation, which shipped in 1907,, 22,600,000 tons as compared with 13,500,000 tons in 1908. It may not be said, however, that the ore shipments, alone, measured the relative activity of operations on all of the ranges, for on the Mesabi the work of stripping old and new properties proceeded at much the same rate as in 1907 and on the Great Northern lease properties in particular considerable progress was made in exploration and development. On the old ranges, where development and mining keep more closely in step with each other, perforce, it was indeed quiet.

Of the total tonnage forwarded, 17,231,804 tons came from the Mesabi range. This was about 68 per cent of the total as compared with about 66 per cent in 1907. The Gogebic range increased its percentage of the total shipment from 8.6 per cent to 10 per cent with a lake shipment of 2,513,670 tons. The greatest comparative falling off was on the Marquette and Menominee ranges where in 1908 only 19 per cent was shipped as compared with over 22 per cent in 1907, and only 52 per cent of the 1907 output was mined in 1908. The Steel Corporation shipped in 1908, 53 per cent of the total as compared with 56 per cent in 1907. The comparisons are of interest in showing how the general proportions in the movement of the various ores are maintained despite the great contrast in total tonnages.

Vessel Movement.

On the lakes the ore carrying vessels accommodated themselves to the lack of cargoes by staying in port, most of them until June 1, many until July 1 and some throughout the season. Prior to June 1, only 285,315 tons of ore had been sent down the lakes, or 6,000,000 tons less than at the same time in 1907. By the end of July the movement had increased to only 2,870,997 tons or nearly 10,000,000 tons behind 1907. For the remainder of the season the monthly shipments averaged a little over 4,000,000. The independent carriers were the worst sufferers and it is interesting to note that in the last six weeks orders have been placed for 13 new freighters, most of which are to be operated by interests having their own ore to transport. As a result of the unparalleled spread of forest fires during September and October, the lakes were overhung during these months with a dense pall of smoke, navigation was much delayed and the losses from vessels grounding and going ashore exceeded those of any previous season. The profits of the year were further decreased by a reduction of the freight rate from the head of the lakes from 75 cents to 70 cents. The season of navigation was also marked by the opening on July 23 of the port of Gary, Ind., to which in the neighborhood of 750,000 tons of ore were brought. Eventually the receipts at this place will amount to 5,000,000 tons a year. The steel ore dock at Two Harbors, the construction of which was begun a year ago, was put in commission in November. It is to be regretted that even in a year so little early activity and demand for ore there should have been further loss of life and property through persistence in navigating Lake Superior after the winter storms have set in. Many sad experiences seem not to have been sufficient to prevent the loss of the steamer D. M. Clemson with a crew of

24 men during the first week of December. The Clemson was a first class steamer 448 feet long and was one of the Provident Steamship Co.'s fleet.

Concrete Shafts.

Among the most interesting of the year's developments has been the increased use of concrete and the methods of the Foundation Co. in sinking difficult shafts. The possibilities which were opened up by the methods inaugurated with the sinking of the Syracuse and Bangor shafts in 1907, have brought others than the Foundation Co. into the field, but thus far all of the shafts attempted have been contracted for by the pioneer interest. These shafts include beside the Bangor and Syracuse, a shaft at the Smith mine, the Northwestern, the Kidder and the North Lake on the Marquette range, the new mine of Tod-Stambaugh, southwest of Hibbing, and a shaft at the Hill mine in the Coleraine district just contracted for by the Oliver Iron Mining Co. A variety of conditions prevails at these widely separated locations, but in meeting all of the different conditions of heavy water, quicksand, depth and broken up ledge, these concrete shafts have been uniformly successful to an extent that places them far ahead of other shafts wherever the size of the ore body justifies the greater first cost and where difficulties are apt to be encountered.

The general design of these shafts and the methods of sinking are familiar. Where the depth to ledge is not great, that is, 75 feet or less, a rectangular shaft is put down and for great depths a circular cross section has been adopted. The shallower depths do not demand so great strength in a shaft and therefore it is advantageous to use the rectangular section which has a lesser displacement. For sinking these shafts a straight pneumatic method is used. Circular shafts are naturally stronger and they may be sunk by digging from the center with a clam shell bucket. In sand the central excavation will induce a uniform slippage or inflow from all points of the circle and the shaft will drop uniformly. All of the concrete shafts are drop shafts. Where the character of the ground is not uniform, other methods are brought into use. The concrete is reinforced vertically and horizontally and where 6-foot walls were used at Embarrass lake, it has been found that from 3 feet 6 inches to 4 feet 6 inches is ample and this thickness has been used in the later shafts. All of the shafts are designed with an inside measurement at the top at least 2 feet greater across than at the bottom. This difference is taken up by offsets, usually 6 inches, in the walls of the shaft. In event of the shaft being out of plumb when finally put down, this provision still permits of the separators being built in in perfect alignment. So far it has not been necessary to take advantage of it.

The Smith Shaft.

The Smith shaft was the first of the Marquette range shafts to be put down. The depth to ledge there, is 73 feet and the shaft 14 feet 10 inches by 10 feet 10 inches inside. The concrete walls are 3 feet 6 inches thick, the shaft is 2 feet larger at the top than at the bottom and it was sunk under air pressure. Figs. 1, 2 and 3 are views of this shaft. Fig. 4 shows the joint of the shaft and the ledge at which point there is no water seepage at all. In fact, the shaft is making less than 100 gallons altogether. This is interesting when compared with the test made on the ground before the shaft was sunk. It was first intended to sink a wooden drop shaft and some 14 feet of this shaft had been built and set up. At this point, three 6-inch perforated pipes were put down into the ground and with two No. 12 pumps the water level could not be affected in the least.

Fig. 3 shows the wall of the shaft and the cast iron brackets bolted into the concrete to serve as bearing brackets for the steel separators. The location of these brackets is laid out after the concrete work is completed to insure correct alignment. This method differs from that to be adopted in the Steel Corporation's shaft at the Hill mine, where the steel separators will be built in independently of the shaft walls. Then, after they are erected, concrete will be filled in around the ends of the steel imbedding them and giving a finished interior of the exact shaft dimensions. Figs. 1 and 2 show the top of the Smith shaft. Here the concrete on which the steel head frame will rest has been extended high enough above the ground level to permit of building a concrete tunnel through which cars may be run into the cage. The advantage of this arrangement at the shaft head needs no comment.

The Northwestern and Kidder shafts are not far from the Smith. As has been described previously, the work at the Northwestern was stopped after a depth of 40 feet was reached owing to a defective tax title to the land. Work has not been resumed since. This shaft is circular, inside diameter 15 feet and walls 4 feet thick. The ledge here is little less than 125 feet below surface. When work was stopped on the Northwestern, the Kidder, which is a duplicate of the Northwestern, was begun. This shaft is now down 8 feet into ledge at a depth of 112 feet. Within the next two or three feet it is expected the ledge will be solid enough to make a joint. Work is just being started on the North Lake shaft, which will be a counterpart of the other circular shafts.

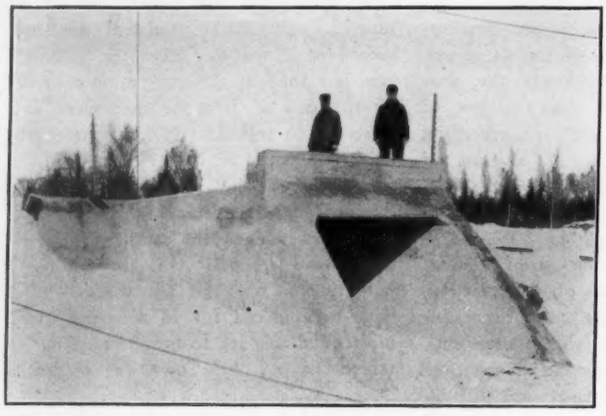


FIG. 1—CONCRETE TUNNEL AT THE MOUTH OF THE SMITH SHAFT.

FIG. 2—MOUTH OF SMITH SHAFT.

New Conditions.

The shaft being sunk for Tod-Stambaugh near Hibbing will meet conditions not encountered previously in the Lake Superior district, especially with regard to depth. The ledge here is 200 feet below surface. The shaft is already down 50 feet, but the difficulty of putting it down another 150 feet, from the standpoint of friction alone, is easily apparent. Plans have already been devised whereby a pressure of 4,000 tons may be put upon the shaft to assist in dropping it. The shaft is to have an inside diameter of 21 feet, but it is being made large enough, so that, if it should stick, a second shaft may be dropped inside of the first one. The shaft is being sunk on the edge of a swamp and where, with the exception of 22 feet of surface, it will drop through sand. The location is not far from the old Penobscot mine and the water conditions will be a parallel to those which caused the shutting down of that mine. The Hill mine shaft will be a drainage shaft. In stripping the Hill considerable water has been encountered and by putting down this shaft, which will bottom in ore, it is hoped to drain a large area in that section. The same object was gained at the Canisteo and Walker pits by the digging of a large ditch around two sides of the pits. At the same time, a great deal of water was continually handled in the Canisteo shafts.

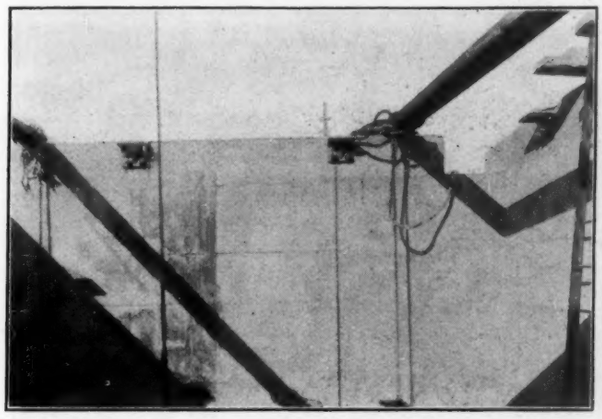


FIG. 3—VIEW OF CONCRETE SHAFT WALLS, SHOWING CAST IRON BEARING BRACKETS BOLTED INTO CONCRETE.

FIG. 4—VIEW IN SMITH CONCRETE SHAFT, SHOWING THE JOINT WITH THE LEDGE.

Mesabi Range.

The problem on the Mesabi range during the past season has been to keep shipments within the proscribed limits and at the same time operate with some degree of economy. It was indeed a sorry spectacle in the early months of the summer to see most of the large open pits painfully idle. Even the Hull-Rust and Burt mines, which were the only mines on the range to ship more than 1,000,000 tons during the year, were operated in a desultory fashion. It was only by a vigorous program after the passing of mid-summer that 2,000,000 tons was obtained from the one and 1,000,000 tons from the other. But two interests, Jones & Laughlin and the International Harvester Co., continued to work at a nearly normal rate. The record of things done is therefore largely concerned with development work. In 1907, there was stripped a little less than one yard of overburden for every ton of ore shipped from the Mesabi while in 1908 there was one and one-half yards of stripping for every ton of ore shipped. Figures published in October show that the yardage of earth stripped in St. Louis county during the year ending June 30, 1908, was 18,795,460. This would not include the yardage removed at Nashwauk and in the Coleraine district for which 6,000,000 yards may be reasonably allowed. The yardage for the year ending Dec. 31 could be approximately the same, or between 24,000,000 and 25,000,000 yards.

Pickands, Mather & Co. have had a season long struggle with water conditions at the Bangor and Syracuse mines, but latest reports state that the shaft in the Bangor is down to the ore body and progress is for the first time being made against the water. It is understood that the Yawkey mine will be thrown up after this year. Elsewhere on the range their properties, the Corsica, Minorca, Utica, Albany, Troy, Malta and Cyprus, have been operated on much reduced scale, except in the very general resumption at the end of the year.

The Tod-Stambaugh Co., which operates the Biwabik mine and to which a supply of Bessemer ore is especially desirable, leased from George H. Crosby and Coates & Miller the Bessemer ore property in 11, 57-21, southwest of Hibbing. The mine will be a costly one to open, but it contains several million tons of Bessemer ore and a large quantity of leaner grade. The Foundation Co. is now sinking a shaft which will eventually be 400 feet deep. The Republic Iron & Steel Co., which has a comparatively short term lease on its Schley property adjoining its Pettit mine and the Gilbert mine of the Steel Corporation, pushed forward actively the development so that as much may be taken from the mine as possible. A shaft was started during the summer. The same company will probably begin work this winter on another new stripping property near the old Alexander mine and known as the Bray. At its Franklin group, near Virginia, an extension of the Bessemer mine deposit is being developed, a new South Bessemer shaft was put down and the Victoria shaft was abandoned. Work was resumed on the Monica shaft, which was abandoned temporarily on account of water and quicksand and a further exploration of the ore body has shown a larger tonnage.

Hanna Operations.

M. A. Hanna & Co. let the contract early in the year for the stripping of the Sliver mine at Virginia and in the latter part of the summer began shipping ore. It was planned to get out 50,000 tons in 1908 and it is generally understood that the five-year contract entered into by this interest for the sale of 1,000,000 tons of ore was based on the output of this mine. The Hanna mine near Mountain Iron, the stripping of which was started in 1907, was also brought to the shipping stage.

The Pittsburg Iron Ore Co. pulled the pumps at the Hobart and Nassau mines last winter and the mines will

remain idle indefinitely, as they have been all of this season. The Brunt mine was also idle all year and when operations are resumed there, it will be to begin stripping, to which method of mining the property lends itself with great advantage. At the La Rue, a contract for 350,000 yards of stripping was let early in the year to Butler Bros., who are also stripping the Sliver mine. Nearly double this amount of stripping remains to be done in the development of the mine. Shipping at the La Rue was not begun until Oct. 1, so that the Croxton mine was the only one of this group to ship throughout the season. At the Croxton, a complete change was made. Formerly a milling pit, it has been changed to permit handling the ore with a Thew shovel, mine cars and dinky locomotives. The adoption of the steam shovel involved getting it down into the pit 120 feet deep, the shovel weighing 35 tons. It was put down over the bank in two hours and a half.

FIG. 5—A VIEW OF THE JACKSON MINE. ONE OF THE FEW MARQUETTE RANGE OPEN PITS.

Stripping the Shenango.

The stripping of the Shenango mine was very actively pushed with two shovels in the pit and a third one operating part of the time. At the present time, this is the heaviest stripping on the range, a depth of 110 feet having been attacked, and early in September 30,000 tons of ore had been shipped from a part of the mine from which this much surface had been removed. It was expected to obtain nearly 100,000 tons from the pit before the close of the season. The present winter work will include a changing of the approach to the other end of the pit. The No. 2 Webb deposit, also controlled by the Shenango Furnace Co. and on which a shaft was started, has been abandoned as an underground proposition and will be stripped. This work is now cut off by the approach to the Sellers mine. Various other of the independent interests conducted development work of interest. Joseph Sellwood is about to open a new property near the La Rue mine. The lease of the Alberta mine at Virginia was thrown up at the end of the season and the interests operating it under the name of the Euclid Mining Co. are stripping the deposit proved up on the shore of Longyear Lake by the White Iron Lake Iron Co. The ore deposit is of small tonnage and runs up under the town site of Chisholm. The same interests have taken over the exploration on the town site of Virginia, where an ore body of a few hundred thousand tons has been located. The Pearce mine developed another small deposit of ore and a new shaft was sunk. The New York State Steel Co. has successfully opened the Kellogg mine after severe shaft troubles and is shipping.

The development work carried on by the Oliver Iron Mining Co. was practically on the same scale as in 1907. At the Hull-Rust property, the stripping area was extended eastward to the Hull and Rust underground mines. In midsummer, the Hull mine was abandoned under ground and the same course will be pursued with respect to the Rust. It is difficult adequately to convey a true idea of the magnitude of the work in progress farther than to say that

the stripping extends in one direction for fully a mile and a half and in many places is over a half mile across. Dozens of steam shovels with two and three trains of 12 to 15 dump cars serving each shovel are removing the surface from above the ore at the rate of tens of thousands of yards daily. A new approach is being cut in from the east that has its outlet to the south under the Duluth, Missabe & Northern tracks in a direction that may become the right of way of the Missabe road into Hibbing when the stripping of the Sellers, Webb and Susquehanna shall have cut off the present entrance.

Very Heavy Stripping.

In the Sellers and Burt pits, nine shovels were stripping all year, which, at the rate of stripping accomplished a year ago, would mean the removal of about 7,000,000 yards in these two mines alone. The surface has been so removed as to connect the two pits, causing the abandonment of the Sellers mine under ground and opening a pit a mile long. The first ore was shipped from the Sellers pit also, about Sept. 1. At the Morris, Monroe-Tener, McKinley, Gilbert, Hartley and other pits, the areas have been materially increased. At the Adams mine, Eveleth, the stripping to the west has been carried over on the Leonidas property and the first shipments were made from there. In the other direction, the former underground workings are being stripped and the shafts dismantled.

At the Virginia group, the development work is especially noticeable. The work of stripping the Norman, Ohio and Lone Jack mines was finished about the first of the year, and at the same time, urged on by the prospect of not being able to extend the lease on the property, preparations were made to mine these deposits as rapidly as possible. Two new shafts were put down, one on the south side of the pit and one at the east end. Both are equipped with steel head frames, following the practice inaugurated on the Mesabi at the Spruce and Gilbert. At one time the deposits were considered too shallow and the life of any one shaft too brief to warrant steel shafts, but in the case of the Steel Corporation steel head frames offer another use for steel and with the large number of properties to equip, steel head frames may be transferred from one to the other just as any other part of the equipment. New power and boiler houses of standard design were built and a remarkable contrast to the appearance of this property early in 1907 has been established in the one year.

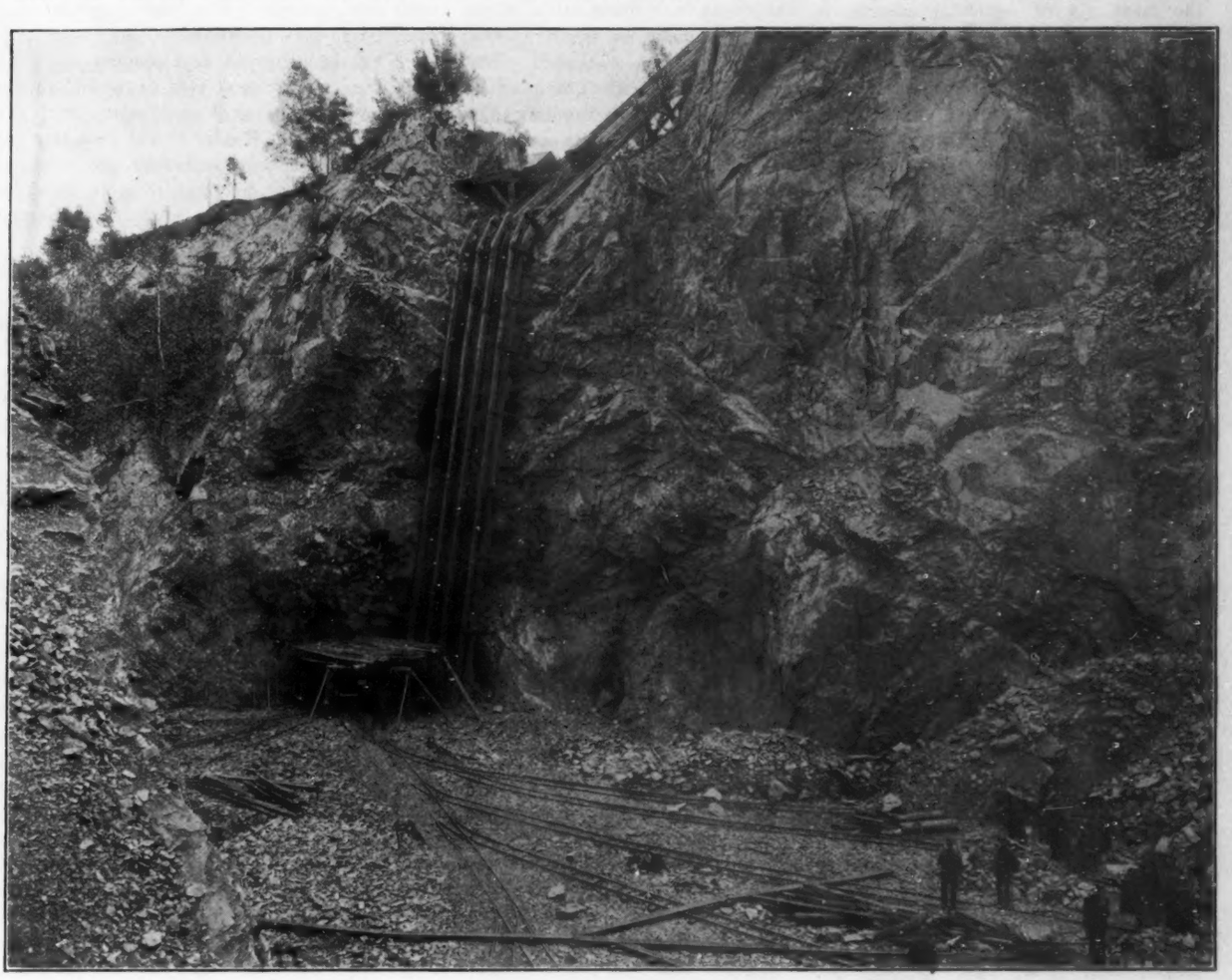


FIG. 6—ANOTHER VIEW OF A MARQUETTE RANGE OPEN PIT. THIS WITH FIG. 5 AFFORDS AN INTERESTING CONTRAST TO THE MESABI OPEN PITS, BOTH AS TO SIZE AND GROUND CHARACTER.

Extending Pits.

At Coleraine, the work of extending the Canisteo and Walker pits has been conducted without stoppage throughout the year. Several million yards of overburden have been re-

moved. Ore could be shipped at any time. The same is true of the Holman mine. The beginning of regular shipments from these properties, despite the fact that they will yield some ore that does not require washing, must await the completion of the permanent washing plant. The railroad grade from the mine to this plant is being built and the actual erection of the plant is a matter of the near future, so that shipments may be expected from Coleraine some time in 1909. A flushing dump for the disposal of muskeg, clays and other overburden difficult of handling on a stationary dump, has been put in operation. A perforated pipe extends along the top of an incline, surfaced near the top with planks. The dump track parallels this incline and when the material is dumped on the smooth boards, its naturally easy movement is accelerated by a continual spray of water from the perforated pipe. Improvements in the town of Coleraine are continually in progress and already more than $10,000,000 has been expended in this district, compared to which the shipments last year were 13,522 tons and this year 4,344 tons.

Several miles northeast of Coleraine, a new mine has been opened on the Hill lands. It is called the Hill mine and is the first new mine to be stripped under the Hill lease. About 1,500,000 yards were taken from the property in the past season, and, as it does not contain a wash ore, shipments will doubtless be made toward the latter part of next year. The Great Northern railroad is extending a railroad line to the property and will carry the ore. The Holman mine, of which one forty is included in the lease from the Great Northern, will doubtless ship some ore next year under this lease as will the Leonard mine also. The Burt forty next to the Leonard is being cut through for an approach, and, as this work has been in progress all of this year, it should be far enough along in 1909 to permit of a resumption of mining in the Leonard which has been dependent since last January upon getting a steam shovel into the pit and having a railroad grade out of it. Other work on Hill lands has been confined to drilling except for the stripping of an approach through a Longyear forty adjoining the Monroe-Tener mine.

Buying a Town.

An interesting part of the work of the Oliver Iron Mining Co. has been the acquiring of the surface rights in the town of Sparta. About the time of the labor troubles on the range in 1907, the Steel Corporation abandoned the underground work at the Genoa mine, which was the principal support of the town of 1,000. It has been decided to strip this deposit and the process of securing deeds to all the property in town was undertaken. It has required all of the year to bring this about, and probably twice as much as the property was worth was paid. The complete abolishment of the village will be required by the mining operators. The moving of houses and goods has not yet been necessary, but a general migration to other towns is in order. The same future lies in store for Hibbing, a part of Virginia and part of Chisholm.

Forest Fires.

The range, like many other parts of the country, was visited during the latter part of the summer by extremely bad forest fires. Not much damage was done to mining property, but strenuous efforts were frequently required in checking the flames. The destruction of the town of Chisholm was the greatest calamity, but no loss of life resulted and the enterprise and character of the reconstruction leave some doubt as to whether the burning was altogether a disaster.

On the Other Ranges.

On the other ranges including the Vermilion, Gogebic, Marquette and Menominee, the interesting developments of the year are few and scattered. Operations were very largely confined to getting out the ore actually needed. On the Vermilion range the historic Chandler mine was abandoned and for the first time since 1894 less than 1,000,000 tons was shipped from this range. On the Gogebic and Marquette ranges, there were no new projects inaugurated and the advancement of exploration work begun in 1907 was much curtailed. The Newport mine began using its new equipment in May and the manner in which the various unique features are giving results is being watched with interest. The work at the Geneva and Davis explorations of the Steel Corporation has brought the time of shipping ore very close and the mining company is erecting additional houses on these locations. The next few years will also see the gradual substitution of steel for wood in mine timbering and in the erection of coal trestles, the first application of which will probably be on the old ranges. A considerable amount of exploration has been in progress all year on the Marquette range in the district west of Ishpeming and on the Cascade range. Shipments, however, were light from all sections and only at the end of the season, when belated orders for ore required rush work in order to ship before the close of navigation, was there apparent anything like a normal activity. In the Swanzy district the Cleveland Cliffs Iron Co. has in progress development work on four new mines, two of which should be able to ship ore next year, the Smith and Kidder. The building up of this district including the town of Gwynn has brought it well along to the position of a settled community.

A Quiet Season.

In decided contrast to the rush of exploratory work in the Iron River and Stambaugh districts concerning which particular comment was made a year ago, has been the quiet aspect throughout the greater part of 1908. Until the first of July, almost none of the old producing properties of this district was in operation and the explorations were generally allowed to lie idle for the year. This temporary idleness has not detracted in the least, however, from the promise which this field gives for future operations and of the long list of ore interests engaged in exploration there all have held to the foothold already gained, awaiting conditions more favorable to expansion. The Cleveland-Cliffs Iron Co. entered the field during the year and began with the exploration of the old Riverton property. The continued success with which exploratory work has met both in the Stambaugh valley and at Crystal Falls has added strength to the belief that a more or less continuous iron bearing formation will be found to extend from the west end of the Marquette range down to this Menominee range district in Iron county. The Rogers-Brown Ore Co. has put the old Gibson mine in shape to resume shipments and ore could have been obtained from there this year. In September there was a very general resumption of both mining and exploration, both at Crystal Falls and at Iron river, and at this writing almost the normal quota of men is again being employed, with a prospect for a busy winter, and new exploration. On the eastern end of the range, the first use of the new Ludington shaft for hoisting all of the ore from the Chapin mine is of in-

terest, as was also the completion in July of the new channel through which the Loretto Iron Co. diverted the Sturgeon river from above its ore body. Of considerable interest to the Menominee range have been the experiments conducted at Iron Mountain by John T. Jones in the perfection of a process which shall be one of the stops in a cheap method of manufacturing wrought iron. Mr. Jones proposes to use the low grade ore which is so plentiful in this district and already the properties which were last year developed by Geo. A. St. Clair at Felch Mountain have been acquired.

On the Cuyuna.

The Cuyuna range has matured rapidly during the year. The leading operator, and in fact the only interest engaged in actual shaft sinking, has been, as in the preceding year, the Rogers-Brown Ore Co., but much more exploratory work is being done of the kind which gives promise of immediately preceding mining operations. Within the last month, George H. Crosby of Duluth took a lease on ground that was being explored for him and on which a hole was put down 200 feet in 57 per cent hematite ore. The progress of the range is also shown in this transaction by the royalty paid for this lease, which at 33 1/3 cents is the high mark reached in this district. Property adjoining the Crosby forty has also been leased. This is at the west end of Serpent Lake in section 11, 46-29. The Rogers-Brown Ore Co., after a great many difficulties, succeeded in putting down a shaft to ledge at its Rabbit Lake property and in addition has developed the fact that the ore in as much of this deposit as findings have been obtained, is for the most part a hard red hematite, high in iron and high in phosphorus instead of being, as first supposed, predominantly limonite. The operations of this company were recently described in THE IRON TRADE REVIEW in detail. The Cuyuna range has not altogether escaped that too prevalent evil of all new mining locations, namely the exploitation of worthless land by stock companies, and within the last six months stocks in Cuyuna range lands have been advertised and sold which are wholly speculative and the longest kind of shots at that. The railroad problem is also being worked with regard to the Cuyuna Range. The Northern Pacific has been surveying spurs into the likely mining locations, as has the Soo line also. The latter road has yet to build its main line through this territory, but the right of way is understood to have been secured. Recently incorporation papers were taken out for an independent road to be built from Deerwood to Duluth, but it is not to be presumed, of course, that there will be two new roads actually built. The exploration work carried on by E. J. Longyear west of Brainerd is reported to have shown encouraging results and it has even been given out that a certain amount of ore from here has been contracted for, shipments to extend over sufficient time to permit development of the district.

The Baraboo District.

In the Baraboo district the Steel Corporation has taken over practically all of the ore bearing lands on which exploratory work has shown at all favorable results. During the year the development of the district was not undertaken actively. Just what made this field attractive to the Steel Corporation has not been made public nor has any intimation been given out as to the probable beginning of mining operations. More effort was expended in the exploratory work under way in the Atikokan district west of Port Arthur, Canada, and a considerable area of ore land has been acquired for the Oliver Iron Mining Co. The investigation that has been under way reveals the existence of a number of magnetite ore formations similar and generally parallel to that being worked by the Atikokan Iron Co. For consumption in the United States this ore is of course subject to duty, but the haul via Port Arthur from mine to furnace is shorter than from the Mesabi district. Railroad connections are now completed also, providing a direct haul to Duluth. The other Canadian district which offers a nearby prospect of shipping ore to the states has been held back during the past year awaiting improvement in the ore market, but the Sudbury and Moose Mountain magnetite ores will certainly be moved in good round tonnage before many years. The following general comparison is sufficient explanation of why this must come about, in addition to which the district is being developed by substantial mining experience and capital. The ore in question is a hard magnetite and it will be mined by open pit methods. It will average in iron close to 60 per cent natural, contains for the most part less than one per cent moisture and will naturally be low in silica. This compares with the average Mesabi ores which run little if any over 50 per cent natural and contain from 10 per cent to 12 per cent moisture. The increased fuel cost for smelting magnetites as compared with hematites is a matter of some question and very recently opinions much more favorable to magnetite have been reached. Granting an increase of from 25 to 30 cents in the cost of coke per ton of pig, part of which would be offset by the reduced moisture of the Moose Mountain ore, there is to be considered the advantage of a rail haul to Lake Huron much shorter than from the Minnesota ranges to the head of the lakes and a lake haul from the docks on Georgian Bay that will be shorter than the Escanaba route to Lake Erie. An approximate comparison of Moose Mountain ore and ore from Hill lands would show in 1909:

	Moose Mt.		Hill Ore.
Royalty	*		$0.90
Rail haul	$0.50		0.80
Lake haul	0.50		0.75
Mining cost	1.00		0.45
	$2.00		$2.90
Additional fuel	0.30	Profit in haul	0.20
	$2.30		$2.70

*Owned in fee. Interest charges negligible.

Added to this minimum advantage of 40 cents a ton in the producing cost of the Canadian ore is the enhanced selling value because of the greater iron content.

Prospect for Next Year.

In the prospect for the coming year there is assuredly more occasion for good cheer than in the outlook upon the year through which we have passed. Already we have a better situation than in January a year ago and the improvement is very sound. It is not likely, however, that the movement of ore will at once mount again to the high point. While there has been an increase of 500,000 tons in the blast furnace capacity during the year and there is in immediate prospect an additional 2,000,000 tons, making a total capacity of 30,500,000 tons, there is still idle or unready for operation 11,500,000 tons capacity. That this situation will operate to partially restrict the shipment of ore seems probable, but the mines may be expected to produce at least 40,000,000 tons in 1909. The increase of open hearth capacity at Pittsburg, the replacement of some Bessemer plants and the operation of the Gary furnaces will noticeably increase the proportion of non-Bessemer ore shipped from the ranges. Up to very recently, the shipments have been from 70 to 75 per cent Bessemer ore, but a very noticeable change from this ratio is already evident. The opportunity for shipping the increased amount of non-Bessemer ore is the key to the extensive and intensive development of the Mesabi range.

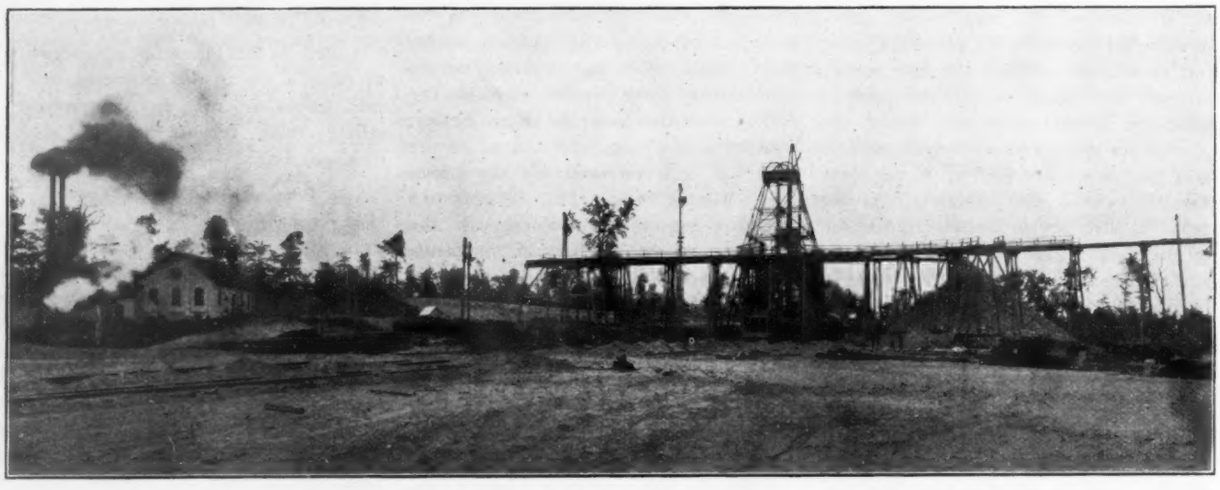
THE SWANZY IRON ORE DISTRICT

Beautiful Town of Gwynn Laid Out With Careful Plans for the Future—Operations of the Cleveland Cliffs Iron Co.

Like the mines of the Marquette range and most of the other lake Superior districts, the several mines of the Cleveland Cliffs Iron Co. at Princeton and to the east, have been shipping very moderately all season. Some ore was shipped from Princeton No. 1 shaft, but at No. 2 the greater part of the ore brought up was put on the stock pile from which a small tonnage was shipped in the early part of the year. Limited shipments are being made from the Austin and Stephenson and at both shafts a part of the output is being stocked. The new development work in this district has progressed to such a degree as to characterize the entire location. The town of Gwynn, named in honor of Wm. Gwynn Mather, the laying out of which was begun last winter, is now a well settled site. Birch and maple trees grew plentifully on the townsite, and in laying out the streets effort was made to save these as far as possible. As a result, much of the natural beauty of the place has been retained and to the peculiar freshness and grace of this kind of tree has been added such attractiveness as comes from symmetry and arrangement.

The principal thoroughfare is a broad avenue, 80 feet wide, with a boulevard of grass and trees down the middle. East and west the streets are named after the various trees, and in the other direction the names of minerals have been applied. The roads are to be built substantially on crushed rock with a gravel overlayer, but at present both the roads and walks have been graded in the sand, which makes traveling rather heavy until the permanent grading is completed.

Like the steel corporation town of Coleraine in Minnesota, which, though it preceded Gwynn in its establishment, yet drew upon the ideas formulated for the building of Gwynn, this town is being built under restrictions intended to add to its cleanliness, orderliness, permanency and general civic welfare. It has been the aim to avoid as far as possible the "company owned shack" rented to employes, and it has been planned to encourage the ownership of their own homes among the miners and residents. Lots are sold and houses built by the mining company to conform to establish designs and regulations so that a certain standard of buildings is assured. It is not intended to encourage buying of lots or building of houses for speculative purposes. It is very noticeable that the lots laid out for the miners' dwellings are unusually large and ample room is provided the owner for the raising of garden truck and flowers. This practice is encouraged by the same scheme of prize giving for many years in vogue at Ishpeming under the direction of the Cleveland Cliffs Iron Co. The houses for the miners and laborers, even to the least pretentious buildings, are large, roomy, double buildings, well painted and entirely lacking anything of the cramped, unsanitary appearance so common to industrial settlements. The sale of liquor is limited and every provision made to secure the permanent and increasing desirability of the town as a place of residence. A $45,000 school house has been built and splendid brick buildings for banking, hotel and other purposes have been erected. The townsite is quite flat and lies in the fork between the beautiful Escanaba river and its east branch. It is about a mile from the present Princeton station on the Munising Railway, but a commodious station is planned for a site already laid out as a part of an attractive entrance into the town. Gwynn gives promise of continuing to be among the most attractive of the upper peninsula towns.



General View of Layout at Stephenson Mine, Swanzy District.

The operating shafts in this district are the Princeton No. 1 and No. 2, with the Stegmiller mine of the steel corporation between, the Austin and the Stephenson. The accompanying illustrations show the general character of surface equipment. The old Swanzy pit, which is also shown, was one of the first operations of the district. The Stegmiller is still an exploration, but quite a tonnage of ore has been taken out in the development work and stock piled. Princeton No. 1 shaft is a three compartment vertical wooden shaft, with but one skip hoisting. At No. 2 shaft, which also has three compartments, the skips are hoisting in balance. The ore stock piles are run out on either side of the shaft in a straight line by building out from each end. The skip

GENERAL VIEW OF SURFACE LAYOUT AT SMITH MINE. CONCRETE SHAFT AT EXTREME RIGHT. HEAD FRAME NOT YET ERECTED.

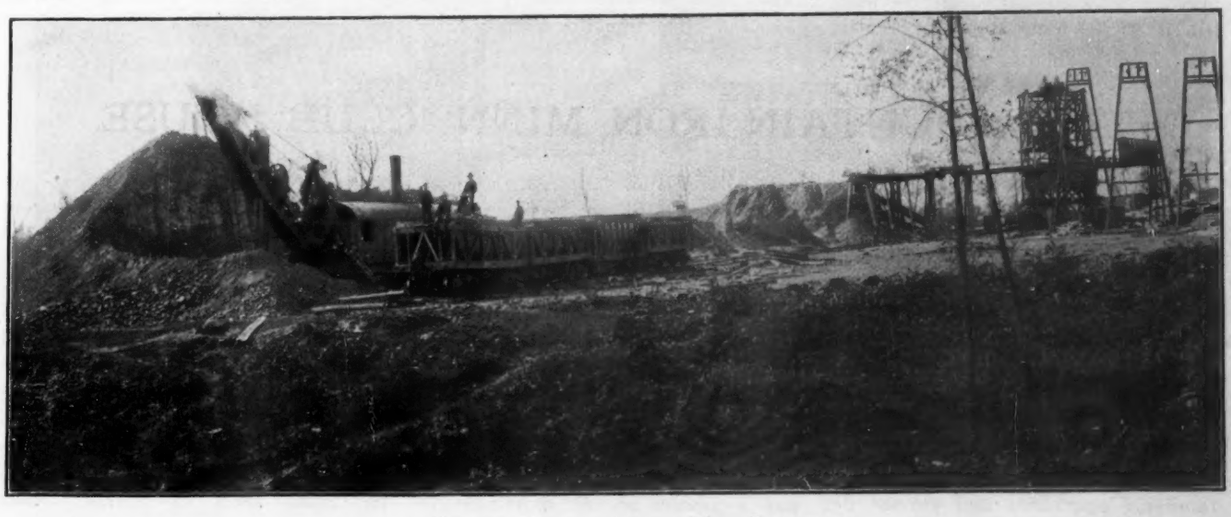
dumps into an end dump car in the shaft house and the car is hauled by an endless cable with a weighted idler out on the end of each pile. The car makes the round trip, which reaches a length of 1,000 feet each way, in about a minute. The cable haulage is operated by a puffer set up in the head frame. The Austin shaft has three compartments, but only one of the skipways is used.

The Stephenson equipment was designed more recently and the arrangement of its shaft is that which is being used in the new concrete shafts being put down in the district. The shaft has four compartments. In this arrangement a long cage compartment is obtained and also considerably more room in the ladderway and pipe passage. Having the skipways on one end avoids all interference from cage or pipes and using side dump ore cars in the mine they can be run by both skip pockets continuously either into a "y" terminal or a loop. This shaft also has a steel head frame as shown in the illustration.

For these mines a central air compressor station has been built, which is a counterpart of the one installed at the Maas mine at Negaunee except that the compressor here was built by the Allis-Chalmers Co. and the Maas compressor was built by the Sullivan Machinery Co. The Maas plant has cross compound steam ends with steam cylinders 24 and 46 by 48 inches and cross compound air end, low pressure cylinder 40 inches in diameter and high pressure 24 inches by 48 inch stroke. Both machines are what is known as 60-drill compressors, and have a displacement at 60 revolutions per minute of 4,000 feet of free air. The plant is designed with a rope drive band wheel and with the steam cylinders outside of the air cylinders, so that the steam end may be uncoupled and the air cylinders operated from the rope drive and an electrical installation.

At this Princeton plant and at the Maas mine the Cleveland Cliffs Iron Co. has adopted the Sturtevant induced draft system, applied to three 350 horsepower Stirling boilers fitted with Murphy stokers and Sturtevant economizers. With this arrangement a less expensive and more easily slacking grade of coal is used and to protect it from weathering it is completely enclosed beneath the coal trestle with finished wood framing. The coal is dropped through the trestle into the housing in the usual way and is hauled for consumption on a narrow gage track to the stokers. The danger from fire has not proven very great.

The new shafts being put down in this district are all concrete shafts sunk by the Foundation Co. The Smith shaft is practically completed and is



GENERAL VIEW OF AUSTIN MINE LAYOUT.

very successful. The Kidder shaft was started the latter part of August and is probably down to the ledge by this time. The third shaft, called the Northwestern, was put down to a depth of about 35 feet before the Kidder shaft was started. This property, which is in section 27, 45-25, was leased from the Chicago & Northwestern railroad, but, because the railroad company's title to the land was questioned, operations were suspended.

Probably due to a belief the property possessed no particular value, it being considered too remote from the iron-bearing formation, it appears that the taxes have been allowed to become delinquent ever since 1878. Tax titles have been purchased by a number of persons since that year, until at the present time the ownership of the land is in a decidedly befuddled state. Indeed it is claimed that there are no records showing that the Chicago & Northwestern Co. ever possessed the tract. The question of title is now in the courts, but it will likely be many months before the problem is worked out, and in the meantime mining work at the property will not be carried on.

There is no doubt now as to the value of the 40 acres. Drilling operations conducted by the Cleveland Cliffs people have shown the existence of a large deposit of ore, and, once the mine is opened, it will be an important producer. The surface material is swampy and sandy, and the shaft location only a few hundred feet from a lake. For this reason it was necessary to put down a shaft of reinforced concrete, and this work was in progress, under contract with the Foundation Co. of New York, when operations ceased. Expecting to handle the ore from the mine, the Chicago & Northwestern has been building a two-mile spur to the property, and this line is nearly completed. The ownership of many other tracts in the vicinity is beclouded in similar manner. Various tax-title holders are interested in them, and thus there is a prospect of a great amount of litigation before matters are finally straightened out. Leases and purchases have given the Cleveland Cliffs Iron Co. control of the great bulk of the mineralized lands in the Swanzey district.

It was in 1856 that Stephen A. Douglas, of Illinois, introduced a bill in congress authorizing the government to deed to the states of the union every odd section of land, this land to be given in turn to railway corporations as an inducement to them to extend their lines over territory where there were no railroads at that time. The Chicago & Northwestern Railway took advantage of the opportunity to secure acreage through territory where it planned to build railroads, and section 27 was included in its possessions. The law specified that no railway corporation could secure lands over six miles distant from proposed right-of-way. It appears that the Chicago & Northwestern paid the taxes on the lands from the time it built its railway through from Escanaba to Negaunee until 1878, or for a period of something over 10 years. Then the taxes were permitted to become delinquent, and hence the present complications which are holding up development work.

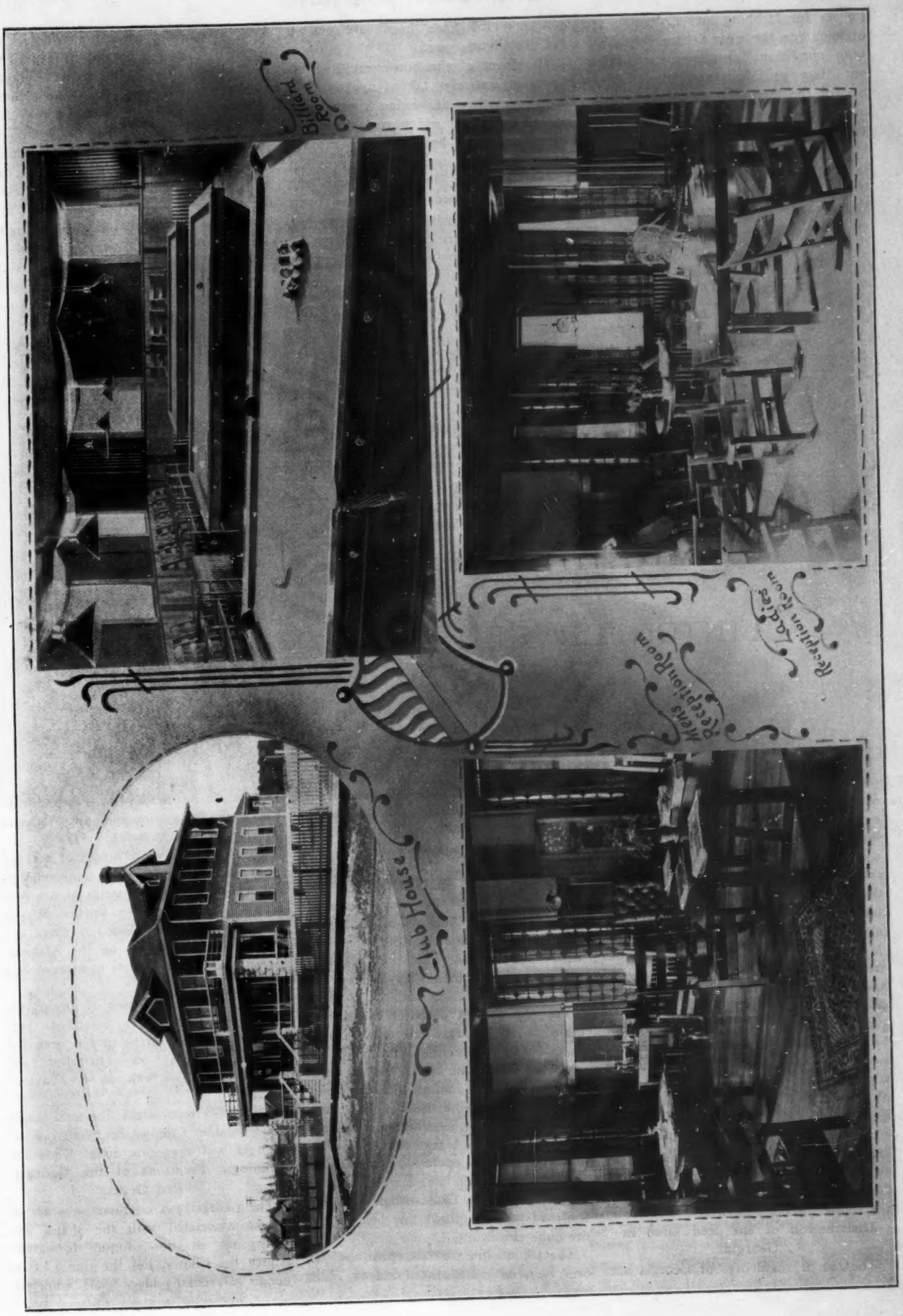
OLD SWANZY PIT NEAR PRINCETON MINE, FIRST OPERATION IN THE DISTRICT.

UNDERGROUND SCENE IN THE CLIFFS SHAFT MINE. SWANZY DISTRICT.

THE MOUNTAIN IRON, MINN., CLUB HOUSE.

Prominence has been rightly given to the large amount of work being done by industrial organizations in the interest of their employes. Many companies have become especially prominent because of their projects in this direction. The great extent of the work carried out by the Steel Corporation is very largely unknown and is unappreciated because swallowed up in the immensity of its ramifying operations and various departments. It is attested, however, by the loyalty of employes and concrete examples, of which the beautiful club house recently built in the Mountain Iron mining district of the Mesabi range and illustrated by the accompanying views is one of many instances. The illustrations show the exterior and interior views of the club house.

General Superintendent M. S. Hawkins, of the Mountain Iron district, was a pioneer in the movement toward the building of club houses on the range and the one at Mountain Iron conforms very largely with the ideas developed by him. In conjunction with the mechanical engineering department of the Oliver Iron Mining Co., the details were planned and, in collaboration with the general superintendents of the several mining districts, a general scheme of club house was worked out with such variations for each district as its particular needs seem to warrant. Club


Billiard Room
Ladies' Reception Room
Mens' Reception Room
Club House

houses for Hibbing and Coleraine are planned for the near future. At Hibbing conditions are somewhat different than at Mountain Iron. It is one of the largest towns on the range and the district is much more concentrated and as a result a degree of strictly social life already exists and is possible aside from club life. For this district, therefore, it has been thought best by General Superintendent West to provide a club that will be a men's club, a place where all of the employes who are capable of appreciating the advantages of it may come for recreation, reading, or whatever a common gathering place of all the men may rightly provide.

At Mountain Iron the employes about the mines, most of whom have been accustomed previously to more or less of social enjoyment, have been almost entirely cut off from any possibility of it. It has seemed, therefore, that to provide for this lack was the most important consideration here and so the Mountain Iron club is essentially a social club without any of the attendant athletic facilities save for the two excellent tennis courts which have been laid out in the club house yard.

The front of the house on the first floor is entirely taken up by two large reception anl living rooms separated by a hall which runs from the front entrance back to the billiard room in the rear. The reception rooms, one for the ladies and one for men when occasion requires, open into the hall through wide doors, so that the entire width of the house is thrown open for social gatherings. As indicated in the views, these rooms are furnished elegantly in dark oak and furnished with tables and chairs of a simple and comfortable style and designed for the purpose. Music and reading are right at hand and the place is most attractive. In the rear, the billiard room is well equipped and contains several tables. Between the front and rear of the house are the steward's quarters, where the steward has a very comfortable room. Adjoining this are kitchen and pantry well supplied with dishes and facilities for handling refreshments for party gatherings.

The ball room occupies the second floor above the reception rooms. It is cosily appointed and is equipped with a piano and a mechanical player for use at any time when an orchestra is not desired. Back of the ball room, with entrance from it and overlooking the billiard room, is a mezzanine gallery which may be used as such or as a card room or refreshment alcove. In the basement are bowling alleys and for this and the other games a nominal charge is made per game. Otherwise the club rooms and facilities are the free gift of the mining company to everyone of the district. In this particular, the liberality of the Oliver Iron Mining Co. and its local officials is especially to be admired, for all of the residents of the district, whether associated with other mining companies or with other enterprises, are welcomed to share the privileges and enjoyments of this club to the promotion of the social welfare of the community. Many social gatherings have been held since its completion and if the common expression of approval and gratification can suffice, the project has been amply justified.

CLINTON OR RED ORES OF GEORGIA

Estimated That These Deposits Amount to Nearly a Quarter of a Billion Tons—Review of a Recent Publication by the Georgia Geological Survey

By Edwin C. Eckel.

The "Report on the Fossil Iron Ores of Georgia," just published by the Geological Survey of that state, is of such importance as to demand more than the usual formal review of an official publication. It is issued as Bulletin No. 17 of the Georgia Geological Survey, and contains 200 pages of text, with numerous maps and plates. Its author, Dr. S. W. McCallie, who is now state geologist, has devoted several years to the study of these ores in both the field and the laboratory. He may be fairly congratulated on placing before the iron trade a volume which contains not only the first detailed account of the fossil ores of Georgia, but also the first satisfactory discussion of the origin of the red or Clinton ores in general. When it is recalled that ores of this type are the mainstay of the iron industry of Alabama and Tennessee, as well as of Georgia, the importance of Mr. McCallie's excellent treatment of the subject becomes obvious.

Distribution of the Red Ores in Georgia.

The red or fossil ores of Georgia are confined to four counties—Walker, Dade, Catoosa and Chattooga—all located in the extreme northwestern portion of the state, in the angle formed by the Tennessee and Alabama boundaries.

Through these counties the red ores outcrop in several long, approximately parallel belts, trending about 20 degrees east of north, and marging the lines where the Clinton formation has been brought to the surface by folding and erosion.

For our present purposes the distribution of the Georgia red ores may be summarized by saying that they are found in three main belts. One of these follows along the eastern flank of Lookout Mountain from near Chattanooga southward until the mountain recrosses the state line into Alabama. On this belt mines are now in operation near Estelle, Bronco, Eagle Cliff and High Point, all on the line of the Chattanooga Southern Railroad, which follows this belt of red ore quite closely.

The second line of outcrop of the red ores encircles the northern end of Wills Valley, and has been worked at and near Rising Fawn station on the Alabama Great Southern Railroad.

The third and westernmost of the red ore areas of Georgia is in Lookout Valley, where two parallel strips of ore outcrop. These have been worked at and near Trenton, New England City, and Wildwood, all stations on the Alabama Great Southern, from five to fifteen miles south of Chattanooga.

Some distance southeast of any of the three main belts above described, there are more isolated areas of red ores, but slightly worked, on Hirtseller and Scraper Mts., as well as on Taylor's Bridge.

McCallie estimates that the total length of workable Clinton ore outcrops in Georgia will aggregate about 175 miles.

Geologic Relations of the Georgia Red Ores.

The Georgia red or fossil ores are of course associated with the shales and sandstones of the Clinton formation. Above the Clinton lies the thin Chattanooga (Devonian) black shale, while be-

low it is a thick series of limestone—the Chickamauga formation. The Chattanooga shale and the Chickamauga lime stones are of importance in the present connection only as affording convenient and easy recognizable horizons from which to measure down or up, respectively, to the iron ore beds of the Clinton.

Going east from Lookout Valley, the entire formation becomes gradually more sandy. The section below, measured by McCallie on the Chattanooga Southern Railroad, near Estelle, extends from the Chattanooga Shale above, down entirely through the Clinton formation to the underlying Chickamauga limestone.

Thickness and Character of the Ore Beds.

The red ores of Georgia occur as regularly stratified beds, near the middle of the Clinton formation. Regarding the thickness of these beds, Mr. McCallie writes as follows:

"In Georgia, where these beds vary

A View of the Underground Workings, Kensington Iron & Coal Co.'s Property, Near Estelle, Walker County, Georgia.

The Clinton formation itself, as the immediate associate of the iron ores, demands more attention. It is made up, in general, of shale and thin sandstones, and varies greatly in total thickness from 500 to 1,500 feet.

McCallie states that the ore beds occur near the middle of the Clinton formation. A section of this middle portion of the Clinton, measured by him near Rising Fawn, gave the following results, in order downward:

SECTION NEAR RISING FAWN, GA.

Bed—	Thickness.
Shale	..
Ore	10 inches
Shale	8 "
Ore	12 "
Shale	1 "
Ore	6 "
Shale	3 "
Ore	6 "
Shale	1 "
Ore	12 "
Ferruginous limestone	9 "
Ore	24 "
Shale	6 "
Ferruginous limestone	4 "
Shale, with thin limestone beds	8 feet
Shale, with occasional sandstone beds	40 "

SECTION NEAR ESTELLE, GA.

		Thickness.
1.	Chattanooga black shale	20 feet
2.	Bluish shale	100 "
3.	Sandy fossiliferous shales	30 "
4.	Blue shales, thin beds of limestone	40 "
5.	Cross-bedded fossiliferous sandstone	8 "
6.	Thin bedded sandstone	20 "
7.	Sandstone and thin bedded limestone	10 "
8.	Bluish shales	20 "
9.	Sandstone and thin beds of limestone	40 "
10.	*Iron Ore*	10 inches
11.	Sandstone	2 feet
12.	Thin bedded sandstone and shale	15 "
13.	*Iron Ore*	18 inches
14.	Sandstone and shale	4 feet
15.	*Iron Ore*	24 inches
16.	Thin bedded sandy shale	20 feet
17.	Shales, occasional sandstone and limestone beds	170 "
18.	Limestone and shale	30 "
19.	Chickamauga limestone	..

In the section above, the Clinton formation comprises the beds numbered 2 to 18 inclusive.

from a few inches to several feet in thickness, they attain an aggregate total thickness of something like 15 feet. The workable beds are rarely more than three in number, and more usually they are limited to only one, though at several places two have been worked to a greater or less extent. The main workable bed, which varies from 18 inches to 4 feet in thickness, almost invariably has both above it and below it other beds, but these beds are usually small, or carry a low percentage of iron. The workable beds usually consist of two or more layers of ore, separated from each other by partings of shale or sandstone which may vary from a fraction of an inch to a foot or more in thickness. The shale partings, like the workable ore-beds themselves, are often quite persistent, and can frequently be followed long distances with but little variation in thickness. The sandstone partings, on the other hand, are not so persistent, and

generally change rapidly in thickness from place to place."

A series of five sections measured near Rising Fawn will serve to give a fair idea of the relation of the partings and ore layers. These sections may be summarized as follows:

Total thickness of ore-series, inches	59	62	52	53	49
Aggregate thickness of ore layers, inches	46	46	44	47	36
Aggregate thickness of shale partings, inches	13	16	8	6	13
Number of layers of ore	5	4	4	4	5

Total Reserve Tonnage of Red Ore in Georgia.

Unfortunately Mr. McCallie does not give us an estimate as to the total tonnage of red ores still available in Georgia. The matter seems to be of sufficient general interest to justify an attempt to supply this deficiency.

Using as a basis Mr. McCallie's estimate that there are 175 miles of workable red ore outcrop in Georgia, we may further safely assume that the total amount of ore at any point along this outcrop is at least 30 inches. Any less thickness than this could hardly, under present conditions, be considered economically workable. As a final assumption, it may safely be taken for granted that, if worked, the workings could be carried at least 1,000 feet back from or down from the outcrop.

The remainder of the computation is, of course, merely a matter of arithmetic, but if the fundamental assumptions are sound, the final result must also be accepted as conservative. I am stating these obvious facts thus carefully simply because the final result, when so calculated, shows a total of rather surprising dimensions—230,000,000 tons.

This statement simply means that there are, within the state of Georgia, over two hundred million tons of Clinton ore which could be worked today, without encountering any insuperable difficulty, in case such a tonnage were required by southern furnaces. It does not mean, however, than any considerable fraction of this large tonnage is likely to be worked in the near future. In the adjoining state of Alabama, similar red ores occur, to an immensely greater total tonnage, in thicker beds, and better located so far as fuel supplies and existing furnaces are concerned.

Composition of the Georgia Red Ores.

The Georgia Clinton ores are, of course, in general composition, similar to the red ores of Alabama, and like them are classified by the miner in two groups —"hard ores" and "soft ores." The terms "hard" and "soft" are hardly expressive of the physical facts, for the distinction between the two varieties is based primarily on differences in their chemical composition rather than on differences in actual hardness.

The red ore of the south is, in its typical or original state, a highly limey or "hard" ore. The ore beds are usually underlain by comparatively impervious shales; and in most cases dip at quite high angles. These conditions favor the penetration of the ore beds, near the surface at least, by percolating waters. The result is that near the outcrop, and for some distance down the dip of the beds, the lime carbonate of the original "hard ore" is largely or entirely leached out. This removal of one constituent of course increases the relative percentages of the remaining less soluble constituents, while it renders the ore more porous and friable. The resulting leached or "soft ore" is, therefore, very low in lime, and correspondingly high in iron oxide.

In the table below are presented a number of analyses of Georgia red ores selected from Mr. McCallie's report. Of those given, analyses Nos. 1 to 6 inclusive represent "hard" or unleached ores, while the remaining analyses are of "soft" or leached ores.

MINING HARD IRON ORE ON THE FRANK COSTELLO PROPERTY, NEAR HIGH POINT, WALKER COUNTY, GEORGIA.

EXPOSURE OF A HARD IRON ORE BED ON THE GLENN-WARTHEN PROPERTY, SHOWING LAMINATED STRUCTURE.

FOSSIL IRON ORE STRIPPINGS, NEAR WILDWOOD, DADE COUNTY, GEORGIA.

MINING FOSSIL IRON ORE BY SURFACE STRIPPING ON THE KENSINGTON IRON & COAL CO.'S PROPERTY, NEAR ESTELLE, WALKER COUNTY, GEORGIA.

Origin of the Clinton or Red Ores.

For many years the origin of the oolitic and fossil ores which occur in rocks of Clinton age, has been a much-discussed subject. Disregarding minor points of difference, it may be said that the various theories which have been advanced to account for the origin of these ores can be reduced to two. These two opposing theories are, briefly stated, as follows:

1. *Original deposition*: The ores were formed at the same time as the rocks which inclose them, having been deposited in a seam or basin, along with the sandstones and shales which now accompany them.

2. *Replacement*: The ores are of much later origin than their inclosing rocks, having been formed by the replacement of original beds of limestones by iron brought in by percolating waters.

In addition to the questions of purely geologic interest which are connected with the differences of opinion as to the origin of the Clinton ores, the matter has a very distinct practical bearing on the working of the ores. This phase of the subject may be stated as follows:

If the ore deposits are due to the replacement of a limestone, we can expect them to rapidly decrease in value and in depth, becoming lower in iron and higher in lime, until at no great depth the bed will consist entirely of unaltered limestone.

If, on the contrary, the ore deposits are original, no such regular decrease in richness is to be expected as the mines are driven deeper. Patches of low-grade ore may be struck, but these will be due to original differences in the richness of the ore, and a slope might pass downward through such a patch of lean ore into another zone of high-grade ore.

In the report under review, Dr. McCallie discusses the origin of the Clinton ores in very detailed fashion, and brings forward facts and arguments pointing toward their possible origin through the alteration of beds of glauconite or greensand. This portion of the report cannot be even adequately summarized in the space here available, and the reader interested in the origin of the Clinton ores must be referred to the original report for a full discussion of the matter. Dr. McCallie has made out a strong case for his greensand hypothesis, and it only remains to be seen whether or not it will stand the test of close study in other districts.

ANALYSES OF HARD RED ORES, GEORGIA.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Ferric oxide	45.29	52.16	42.47	51.91	53.40	56.86	81.57	77.04	77.66
Ferrous oxide	2.65	1.70	3.15	1.94	1.34	3.75	0.00	0.00	0.07
Manganese oxide	0.28	0.21	0.29	0.22	0.08	0.58	0.43	0.69	0.22
Silicon	7.28	10.52	7.00	5.18	6.41	4.98	6.55	11.85	9.32
Alumina	3.14	5.22	5.45	5.98	11.89	2.78	5.57	5.21	5.33
Lime	21.41	15.23	22.70	16.82	14.89	14.48	0.29	1.02	1.25
Magnesia	0.44	0.06	0.59	0.05	0.16	1.95	0.42	0.47	0.33
Sulphur	trace	0.06	0.02	0.04	0.01	0.06	0.25	0.04	0.01
Phosph. pentoxide	1.17	1.83	0.96	1.08	1.28	1.15	0.45	0.62	1.65
Carbon dioxide	16.50	11.01	15.20	12.34	8.42	12.40	0.00	0.00	0.00
Combined water	2.04	1.75	1.70	3.56	1.96	0.80	3.57	3.01	2.77
Metallic iron	33.76	37.83	32.18	37.85	38.42	42.72	57.10	53.93	54.42
Phosphorus	0.51	0.80	0.42	0.48	0.56	0.50	0.197	0.27	0.72

1. Rising Fawn hard ore. 2. Morganville hard ore. 3, 4, 5. Estelle hard ore. 6. Bronco hard ore. 7. Rising Fawn soft ore. 8. Trenton, soft ore. 9. Estelle soft ore.

The Craig Foundry Co., Long Beach, Cal., has recently been organized to operate the big foundry at the plant of the Craig Ship Building Co., the two companies being closely affiliated. The foundry has been very completely equipped with costly machinery, including a 12-ton ladle and all sorts of castings will be made.

OPEN PIT MINES IN THE

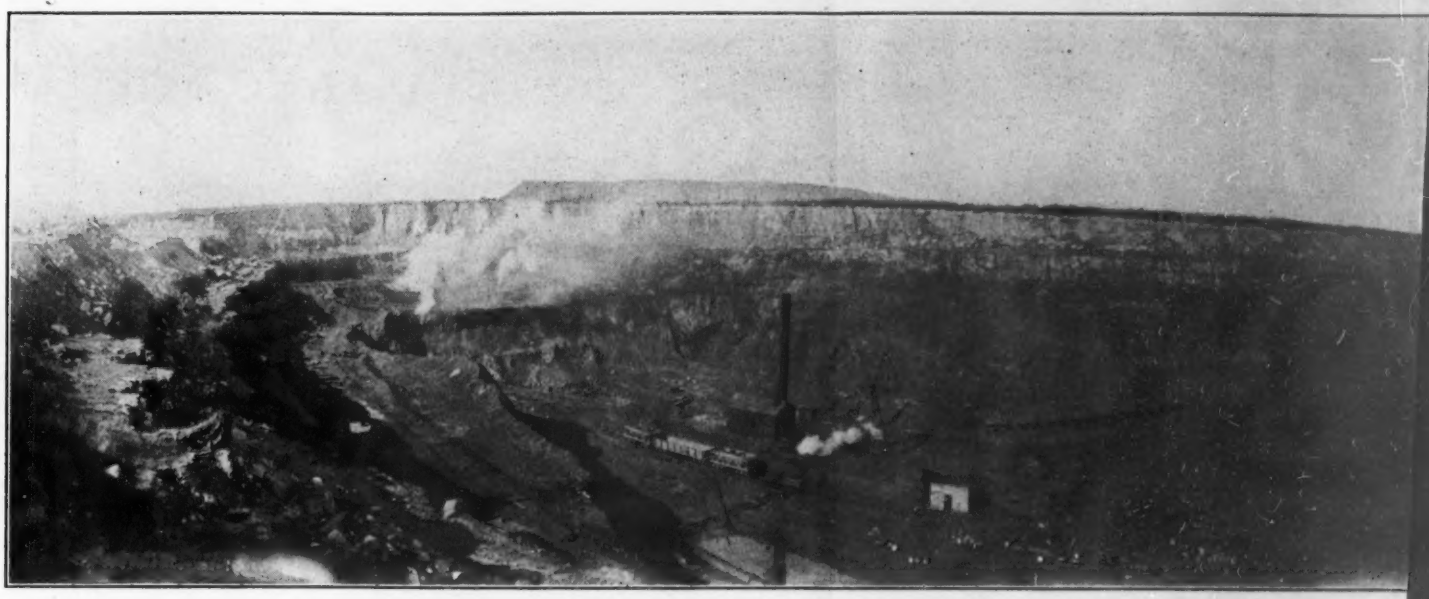


Fig. A—A View of the Burt

This view gives a good idea of the ore pit. In the past three years the end at the left of the view has been practically untouched are shown standing and the end where the shovels a

Fig. B—The Mahoning and

This is an especially natural reproduction of the mines looking toward the east. The Mahoning is on the left and the Hull-R The Mahoning, while laid out to ship a like amount, has curtailed its production to less than 2,000,000 tons in the past two years. The ex presents one of the most striking industrial operations in the world. The expanse included in this view, which does not show the stripping represents iron ore.

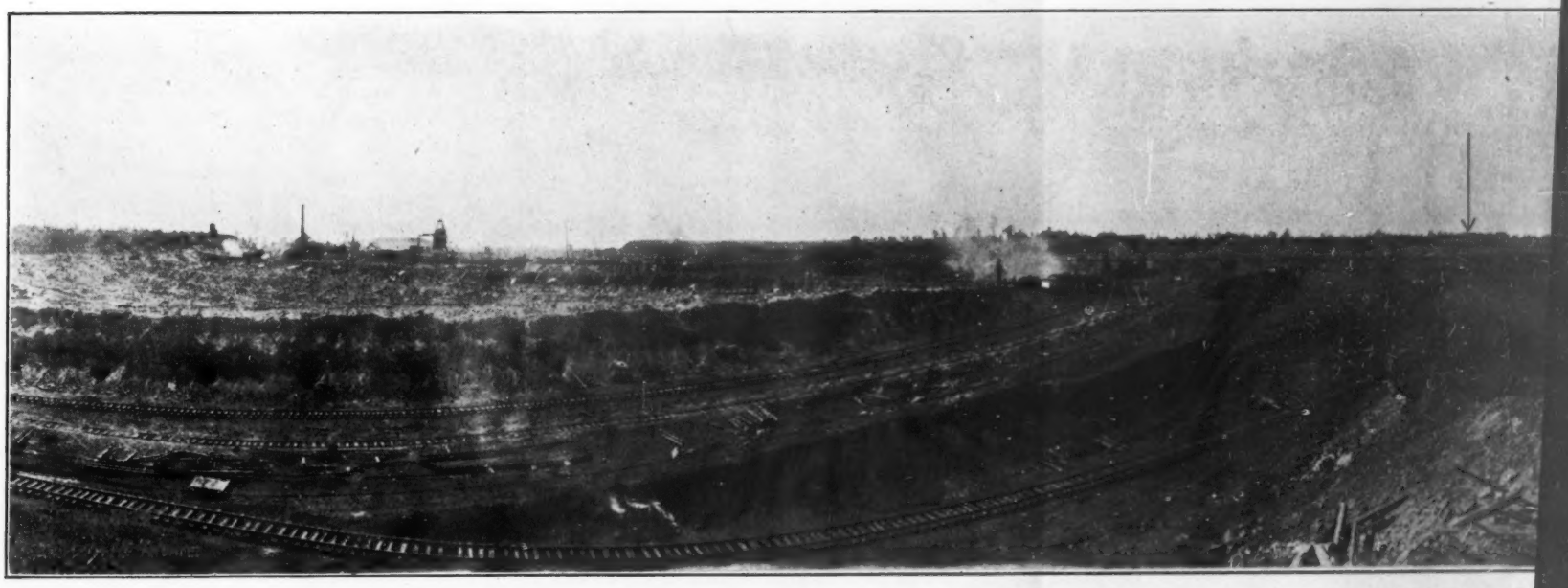


Fig. C—View Showing the Hull-Rust and Mahoning Mi

Some of the stripping work at the east end is shown. The line between the two pits is shown clearly by the difference in at a point about where the projection of the arrows shown would intersect. In that s

OPEN PIT MINES IN THE MESABI RANGE

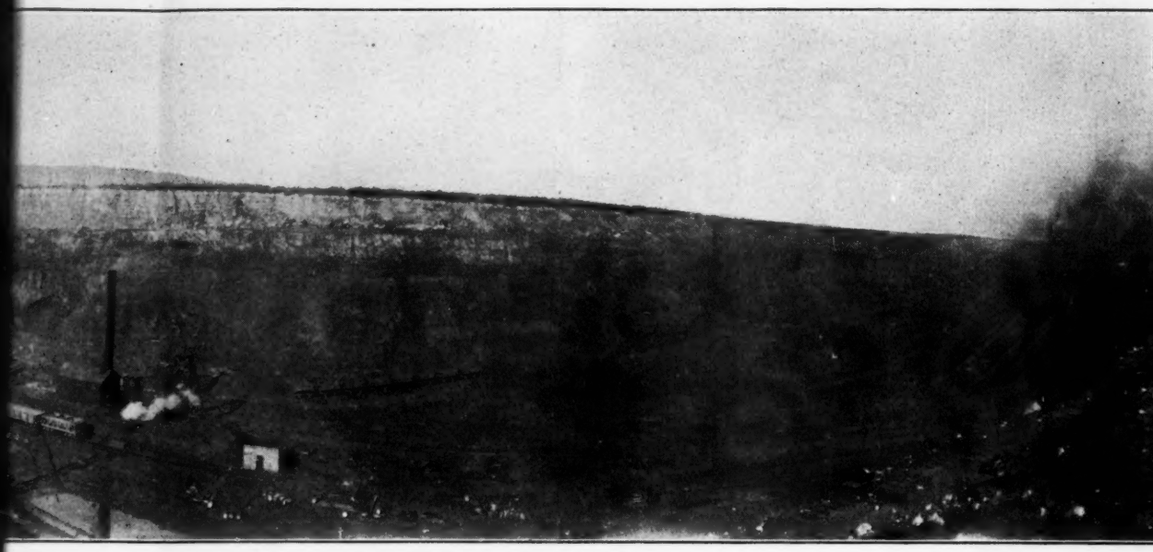


Fig. A—A View of the Burt Mine.

three years the end at the left of the view has been practically untouched and the 3,900,000 tons of ore shipped have been ta
are shown standing and the end where the shovels are shown at work.

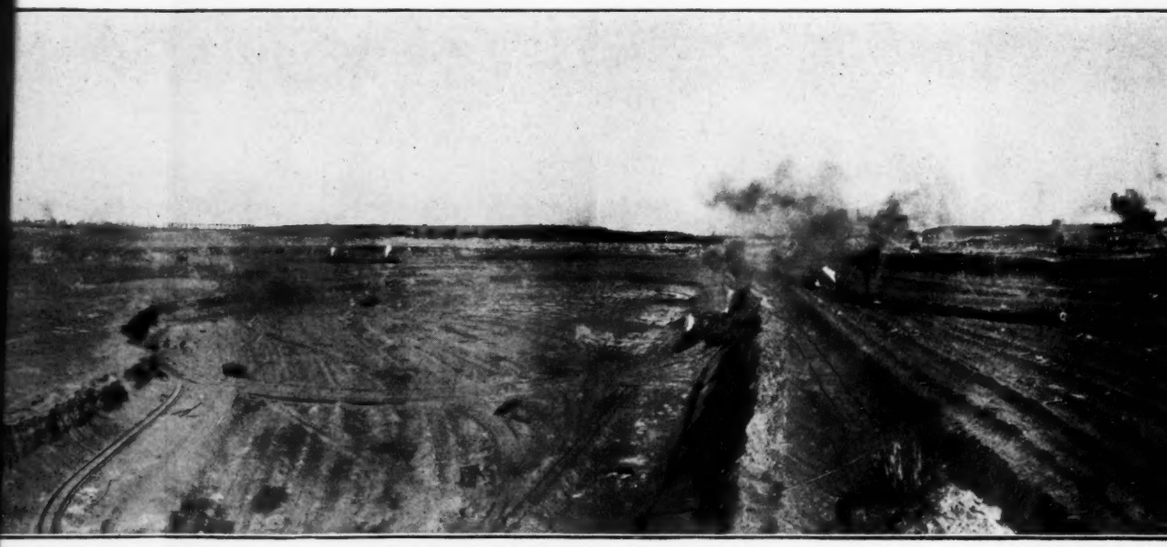


Fig. B—The Mahoning and Hull-Rust Mines.

es looking toward the east. The Mahoning is on the left and the Hull-Rust on the right. From the latter about 3,000,000 tons w
its production to less than 2,000,000 tons in the past two years. The excavation shown represents the partial uncovering of a de
rld. The expanse included in this view, which does not show the stripping at the east end done this past summer, covers an a

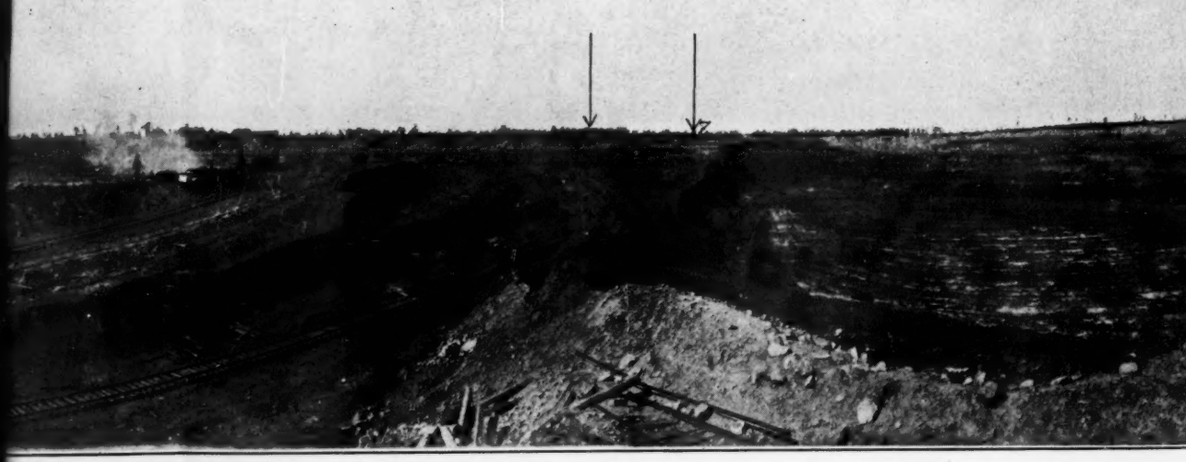


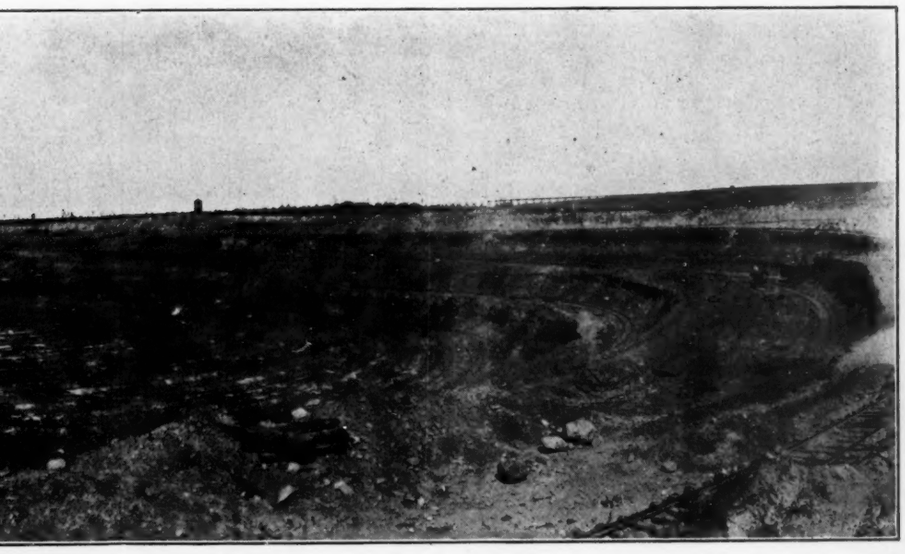
Fig. C—View Showing the Hull-Rust and Mahoning Mines Looking Toward the West.

The line between the two pits is shown clearly by the difference in levels. In the spring of 1906 just enough stripping had be
ut where the projection of the arrows shown would intersect. In that same year nearly 1,700,000 tons of ore were shipped.

GE

have been taken from that portion between where the cars

0,000 tons was shipped in 1907 and about 2,000,000 tons in 1908.
ing of a deposit of more than 200,000,000 tons of ore and assuredly
covers an area a mile square and all of the body of the view



ipping had been done to permit of putting a shovel in ore
ipped.

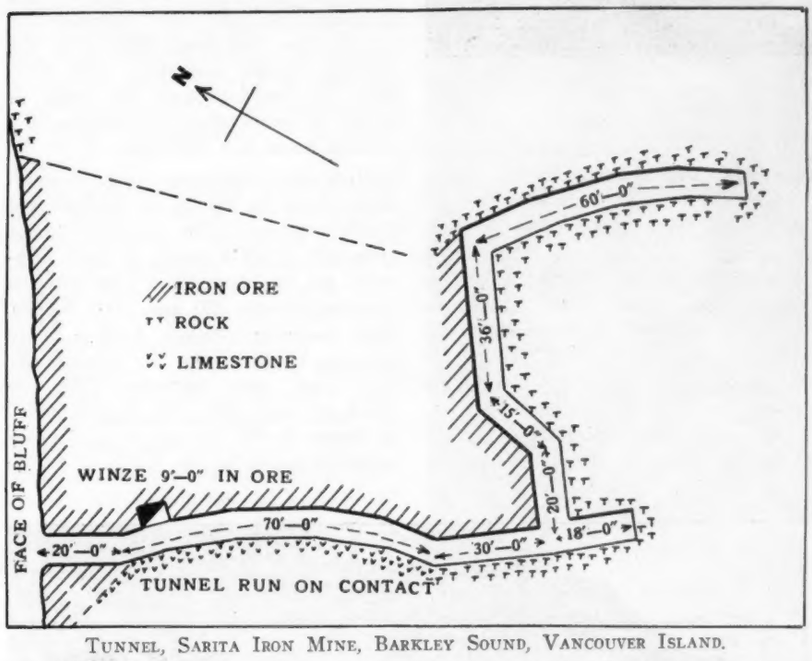
IRON ORE DEPOSITS OF THE PACIFIC NORTHWEST.

By H. Cole Estep.

In the east, as well as in the west, there are two opposite and more or less prevalent impressions regarding the iron ore deposits of the Pacific northwest. One of these impressions is that there is little ore offering immediate possibilities in that territory and that therefore for some time at least that region can not become a large producer of iron, even for its own consumption; the other view, shared by a few misguided enthusiasts, is that there are large bodies of iron hidden under the forests of the western mountains, which await only the magic touch of capital to produce a second Mesabi range and a second Pittsburg on the north Pacific coast.

So far as one may judge from a careful study of the data now available, neither of these views is correct. The evidence points to the existence of a reasonable though somewhat scattered supply of ore. Present market conditions of pig iron, which call for a considerable tonnage, as well as the commercial development and expansion on the coast, warrant the opinion that the coast can become a producer of a large proportion of the iron consumed west of the Rocky mountains. But the coast cannot expect to become an iron-producing center in a national sense such as are Pittsburg, Birmingham and Chicago or many lesser points in the east, for many years to come, if ever, not at least until the eastern ranges have been greatly depleted, the center of population moved much further west, and the present commercial methods of smelting have been still further refined and cheapened.

It is the purpose of this article to make a general study of the iron ore deposits of the Pacific Northwest, more particularly those of the state of Washington and the Province of British Columbia, and to point out the location, nature and extent of the deposits, the mining methods necessary to properly get out the ore, and the transportation problems to be solved. There will also be a paragraph on the supply of fuel and fluxes, and the needs of the future.



Tunnel, Sarita Iron Mine, Barkley Sound, Vancouver Island.

In studying the ore deposits of the northwest, it is convenient to consider separately those in the United States and those in Canada. It is generally considered that the larger bodies of ore are in Canadian territory, and it is known that the quality of the coke coming from the Canadian ovens is somewhat superior to any that has so far been produced in this section south of the international boundary. On the other hand, 95 per cent of the market for pig iron and steel is now in the United States and the United States tariffs militate against the establishment of blast furnaces in Canadian territory. These duties are 40 cents per long ton on ore, $4 per long ton on pig iron and 20 per cent ad valorem on coke.

In Seven Counties.

The iron ores of Washington occur principally in the following counties: Skagit, Snohomish, King, Kittitas, Stevens, Chehalis and Pacific. The ores are generally bog ores and magnetites, while those in Chehalis and Mason counties are of black sand variety. These ores have been fairly well explored, located and analyzed but unfortunately there has been but little examination of the beds from the standpoint of tonnage available. This has been due largely to the fact that there has been no assurance, due to lack of blast furnace capacity, that an iron ore mine once properly developed could find a market for its product; and on the other hand, there has been but little blast furnace development on account of a lack of a sufficient quantity of ore in sight of suitable analysis. Recently one blast furnace interest has undertaken to develop its own ore properties, which policy may provide a partial solution of the dilemma.

In Skagit county the deposits are located on the south bank of the Skagit river between Hamilton and Marble Mount, a distance of 25 miles. The ores are a mixture of magnetites and hematites and, since they range in phosphorus from 0.11 to 1.06 per cent, are not of Bessemer grade. The sulphur is very low, but silica and alumina are high. Five different veins or ore bodies, ranging in thickness from 7 to 50 feet, dipping south and west at an angle of 55 degrees, occur in the region. The ore is found on the side hill and can be easily mined by tunneling. A branch of the Great Northern railway, which follows the Skagit river from Sedro-Wooley to Rockport, supplies the valley with cheap and efficient transportation. The upper reaches of the Skagit river and its tributaries furnish abundant water powers which could be developed for mining as well as general commercial purposes. At Cokedale is a deposit of coking coal which has been worked for some years, producing in 1901, 5,806 tons of coke.

Near Arlington, Snohomish county, on the Northern Pacific railway, is a heavy deposit of soft ore, some of which is now being used in the Iron-

OPEN QUARRY FACE—TEXEDA MINE, TEXEDA ISLAND, B. C.

dale furnace at Port Townsend, Washington. The Irondale Furnace Co. has developed the bed to some extent. The ore is loaded on cars and transferred at Everett or Annacortes to scows, on which it is taken to the furnace. No definite figures on the extent of the deposit can be given; estimates vary from 72,000 to 1,500,000 tons. It runs about 50 per cent iron, has very little sulphur and is declared to be one of the easiest smelting ores in existence.

Discovered Some Years Ago.

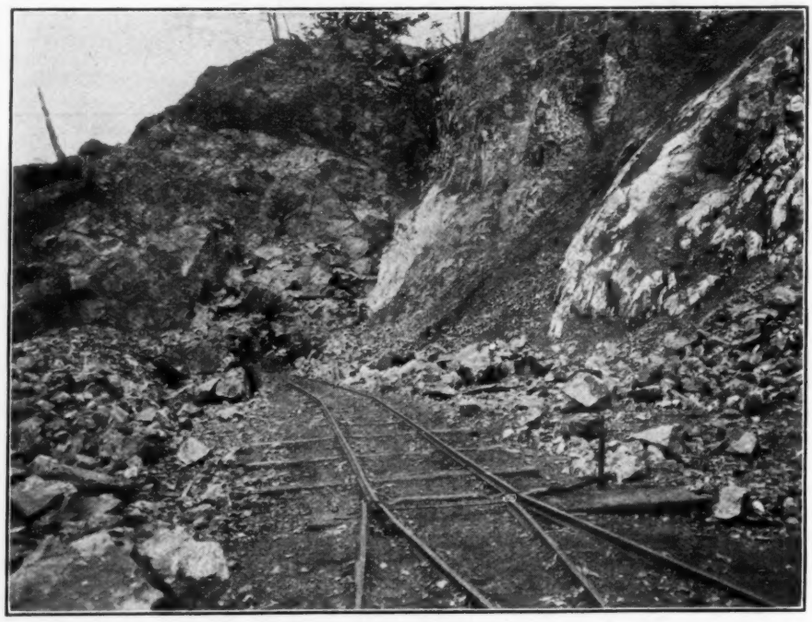
Other important deposits of iron ore are in King and Kittitas counties, on the west and east sides of the Cascade mountains, respectively. Those in King county were discovered in 1881 by F. M. Guye, and in 1889 a company was organized to build a furnace at Kirkland, near Seattle, which was to use these ores, and also those from the Clealum district across the divide; but the company never realized its expectations. The ores are of interest now because the new trans-continental line of the C., M. & St. P. railway passes directly through the district and solves the problem of transportation. The iron lies on the south fork of the Snoqualmie river near the summit of the Cascade mountains, and in the valley of the Clealum river about 20 miles north of Clealum, a station on the main line of the Northern Pacific railway.

The ore on the west side of the mountains occurs in beds, or isolated masses, but not in veins and is a true magnetite. The Clealum ores on the other hand are in veins varying from 5 to 30 feet in thickness and are a mixture of magnetites and hematites. They can be mined by the usual methods of tunnels and shafts, while certain deposits can be quarried in open pits. Timber is abundant, while the adjacent large, developed water powers of Snoqualmie Falls and the Cedar river could furnish plenty of electrical power. The ores are of good quality and occur in extensive masses.

Coke Supplies.

Stevens county is situated in the extreme northwestern corner of the state, and while it contains a fair supply of iron and fluxes, it is some 400 miles by rail from tide water and an available American fuel supply. This ore is only about 80 miles from the Fernie, B. C., coke ovens, which are producing a large quantity of coke. Fernie coke, however, has not been considered good for iron smelting, its structure being weak even for copper smelting. There is some bog ore on Clugston Creek, about 20 miles north of Colville, but the quantity is very limited. Other Stevens county deposits which promise workable quantities are in the vicinity of Valley, a station on the Spokane Falls & Northern Railway. (Great Northern.) These ores are limonites and hematites running very high in iron, the maximum being 68 per cent. The sulphur and phosphorus are also high. Considerable of this ore has been shipped to the Tacoma smelter and there used as a flux. It occurs in beds and could be mined by steam shovel. Abundant and suitable fluxes are convenient.

Black sand ores occur in great abundance along the beaches of Chehalis and Pacific counties. The sand contains from 100 to 1,176 pounds of pure magnetite per ton, there being large deposits running between 800 and 1,000 pounds. This magnetite contains from 5 to 10 per cent titanium, but is exceptionally free from other impurities. The ore could be very easily and cheaply mined by steam shovel. It occurs in a region which is tapped by the Northern Pacific



MAGNETITE AT TEXEDA MINE, SHOWING TRAMWAY FOR REMOVING THE ORE, TEXEDA ISLAND, B. C.

railway, and is also provided with excellent facilities for transportation by water. Similar deposits of black sands are found along the Oregon and California coast, and are in fact so extensive in character as to form the largest known supply of iron ore west of the Rockies. A company known as the Rothert Steel Co., with headquarters at Hoquiam, Wash., has been organized to develop some of these ores and manufacture high-grade tool steel therefrom.

British Columbia Ores.

British Columbia ores are found in quantities in two localities: Along the west shore of Vancouver Island and among the islands at the north end of the Gulf of Georgia, the principal one of which is Texeda Island. The commercially possible irons are all magnetites, running from 45 to 67 per cent iron, 4 to 11 per cent silica, 0.015 to 0.7 per cent sulphur, and 0.0 to 0.053 per cent phosphorus. A heavy proportion of them are therefore of Bessemer grade.

The principal deposits occur at Quatsino Sound, Hesequoit Harbor, Alberni Canal and Barkley Sound, on the west coast of Vancouver Island, and on Texeda Island in the Georgian Gulf. These deposits can be economically removed by tunnelling, and in the case of the larger, now operating, mines by quarrying the faces of the cliffs. Most of the deposits are within short distances from and above tide water, so that cheaply constructed gravity tramways could be utilized to get the ore to tide water where it could be loaded in barges for transportation to the furnaces. It is interesting to note that all the deposits along the west coast of Vancouver Island occur in a straight line, parallel with and from 10 to 15 miles back of the coast. The necessary tramways to get out the iron need not be this long, however, for the coast is indented frequently with long, deep canals and bays.

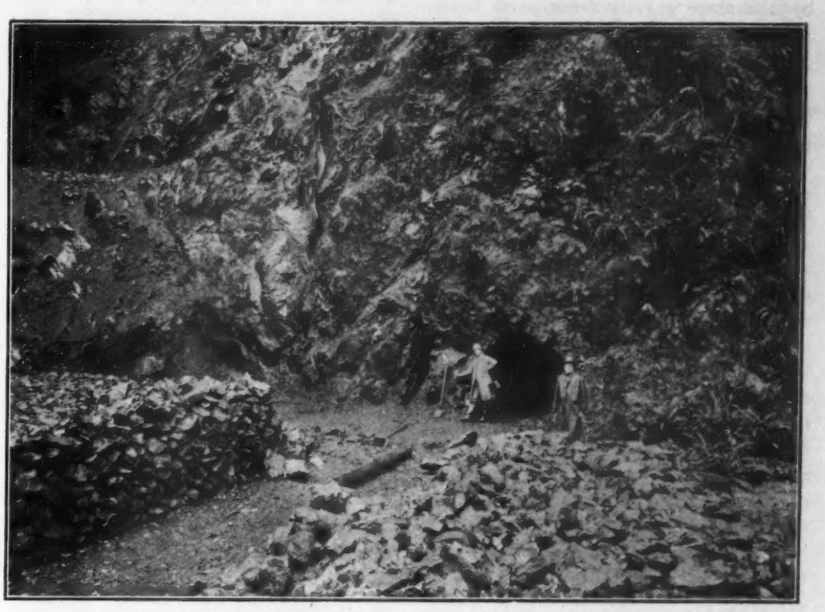
Sarita Iron Mine.

The Barkley Sound ores are found principally along the Sarita river and in the vicinity of Maggie Lake and Seshart Channel, which connects the middle and western channels of Barkley Sound. The chief of these developments is the Sarita iron mine, now controlled by the Irondale Furnace Co. This mine is situated on a long, low ridge about a quarter of a mile from the Sarita river. The western end of this ridge terminates in a bluff about 60 feet high and 200 feet wide, part of the face of which has been cleared off, showing solid magnetite for the full 60 feet height of the bluff, and with a width of 92 feet, but enclosing in this width some 14 feet of country rock, while towards the top of the exposure a large wedge of crystalline limestone shows embedded in the ore. The ore body is bounded on the south by a mass of highly crystalline limestone, and on the north by a greenish fine-grained and apparently much altered volcanic rock. To test the extent of the ore body a tunnel (see page 33) was driven, starting just above swamp level, at the base of the ore exposure and on its contact with the limestone lying to the south. This contact was followed in a southeasterly direction, or nearly with the ridge, for about 70 feet, the tunnel showing solid magnetite on the left and limestone on the right hand side. At 70 feet in the lime gave place to the country rock, and the tunnel, following the ore contact, was deflected a few degrees to the left. The contact was followed for about 30 feet, when the ore, heretofore present on the left hand side, gave out. The tunnel was pushed ahead in the same direction for an additional 18 feet, but without striking any more ore. At the point in the tunnel where the ore gave out a drift had been started in a northeasterly direction and, with certain small bends, had been kept in this general direction, parallel with the face of the bluff, for about 71 feet. The right side of this drift was in country rock all the way, but good solid magnetite formed the left side for the first 30 feet, after which a little ore on the floor was all that could be seen, and even this disappeared before the first 71 feet of the drift had been run.

The ore bodies of Alberni Canal and Hesquoit Harbor are similar in nature, and while promising in quantity, have not, up to date, been sufficiently developed to furnish anything approaching an accurate estimate of the amount available.

Bog Ore.

On the north side of the west arm of Quatsino Sound, near the extreme northern end of Vancouver Island, is a deposit of bog ore from which 1,500 tons was shipped to the Irondale furnace in 1907. The ore runs 52 per cent iron, 0.50 per cent phosphorus, and is practically free from other impurities. The distance of the deposits from the water varies from a quarter to half a mile. Most of the beds are very shallow and for this reason have been abandoned by the furnace company.



EXPOSURE OF MAGNETITE ON BLUFF, SARITA MINE, BARKLEY SOUND, VANCOUVER ISLAND.

The Largest Development.

On Texeda Island, in the Gulf of Georgia, B. C., about 160 miles north of Seattle, Wash., is the largest developed iron mine in the northwest. This deposit is known as the Texeda mine.

The principal ore deposit is situated about a quarter of a mile directly inland from the present wharf, and from 450 to 500 feet above sea level.

The land rises from the sea by a series of benches, the first at an elevation of 250 feet, the second 450. Some 250 feet vertically up the hillside from the second bench there is a bluff point or knoll, on which occurs a very extensive magnetite exposure. Exposures of the same kind, though smaller, show above on the steep faces of a couple of similar terraces, at higher elevations, while indications of iron, still undeveloped, are found for a considerable distance further. The principal workings, large quarries in the face of the bluff, are about 600 feet above the sea, and are connected with the shipping point by a surface gravity tram, with bunkers at the top and bottom. From the upper bunkers a level horse-tram runs a short distance to the east around the flank of the hill to a point just below the present quarries. The working face of this quarry is from 250 to 300 feet long, with a face of from 100 to 125 feet of ore, which is a clear magnetite mixed with rock, apparently altered diorite, now chiefly epidote. As the ore is mined on royalty, only that running 50 per cent iron, or over, is shipped. With such sorting, only about half of the ore mined is shipped, the other half going on to the second class or waste dump. Some 6,000 tons of 50 per cent ore was mined from the quarry in 1902, by a force of seven white men and 14 Chinese.

In 1907, $15,000 was spent by the Irondale Furnace Co. in further developing and improving this property; the improvements include the construction of a tram 1¼ miles long, a 400-foot wharf and extensive bunkers. Other similar properties exist on Texeda Island, among which may be mentioned the Paxton mine, situated on a bench about 450 feet above the sea level and estimated to contain 300,000 tons of 50 per cent ore; and the Lake mine, half a mile east of the Paxton, which includes an ore mass 78 feet high and 200 feet long.

Prospects for Manufacturing.

Charcoal has been used to smelt iron on the Pacific coast, but being manufactured from soft woods has not proven entirely satisfactory. Plenty of good coking coal exists and is being mined. This fuel has been satisfactorily used to smelt iron. The British Columbia coke has the least ash and the strongest texture. There has been no incentive up to date for the local ovens to produce a grade of coke best suited for blast furnace use and it is declared that if more care were taken in cleaning the coal and in the coking operations, the quality of western coke could be materially improved. The price of this coke is high. Washington coke is about $6.50 per ton and British Columbia coke delivered in Seattle is about $11.00 at present. Limestone averaging 99½ per cent calcium carbonate and one-half per cent carbon may be had in abundance. Good silica sand, free from contamination with lime and suitable for acid steel making processes, has not yet been discovered on the Pacific coast, although considerable time and money have been spent in prospecting for it.

The foregoing shows in a rough way the general nature and extent of the North Pacific iron deposits. The question now arises: Are the market conditions such as to justify the development of these deposits and if so, to what extent can this development be safely carried?

Estimate of Consumption.

An accurate estimate of the annual consumption of pig iron on the Pacific coast has not been made in recent years. The following figures were established after a careful inquiry among the dealers in pig iron in Seattle and Portland. They are susceptible to an error of 25 per cent, and of the four territories named the estimate for California is the least accurate. The figures are: British Columbia, 7,000 tons; Washington 18,000 tons; Oregon 16,000 tons; California 70,000 tons. Total, 262,000 tons. Total outside of California, 41,000 tons. In this territory, there are the following number of foundries: British Columbia 18; Washington 70; Oregon 42, California, 165. This number of foundries and this consumption of pig iron are comparatively very small. It must be remembered, however, that with a dependable supply of iron at a reasonable price certain lines of manufactured goods now imported either entirely or very largely from the east would be produced on the coast. In this list we can safely include cast iron pipe, rails, machinery steel and merchant iron, stoves, lumber and saw mill machinery, mining machinery and other manufactured specialities. It is very doubtful if structural shapes, plates, machine tools or other highly specialized machinery will ever be made on the coast in any quantity on account of the extra large investments and the necessarily nation-wide markets demanded by these products. Another factor in the problem is the scrap iron consumption. With cheaper pig iron the foundries would use a larger proportion of pig and less scrap. At present good foundry scrap brings about $17.50 per net ton and, with pig at its present price of about $27.00, the tendency is to use just as much scrap as possible. There is little likelihood of scrap ever becoming much cheaper, so any reductions in the price of pig iron will tend to reduce the proportion of scrap used by the foundries. Furthermore since nearly 50 per cent of the cost of pig on the Pacific coast is due to freight charges and duty, the cost

Analyses of Iron Ores of Pacific Northwest.

Locality.	Iron FE	Silica SiO_2	Phosphorus P	Sulphur S	Insol. residue	Alumina Al_2O_3	Manganese Mn_2O_3	Calcium $CaCo_3$	Authority.
Chehalis County:									
Black Sand (separated)	43.72	.....	.....	.....	24.14	11.65	0.18	.....	Fulmer.
Black Sand (separated)	72.0	0.02	0.01	0.005	Titanium 10 per cent.				Arthand.
Hamilton District, Skagit County:									
From tunnel, Inaugural Mine	43.89	19.98	0.11	.....	.....	3.30	12.30	3.98	Thatcher.
Hamilton Mine	33.88	32.94	1.06	0.16	.....	2.57	7.31	8.81	Thatcher.
Inaugural Mine	43.91	18.36	0.69	.....	.....	3.09	12.00	8.92	Thatcher.
King County:									
Guye Mine	67.13	3.60	none	.....	.....	none	none	none	Shedd.
Denny Mine	62.45	5.78	none	0.21	.....	5.34	none	none	Shedd.
Kittitas County:									
Laminated Ore, near Camp Creek	47.10	8.70	none	trace	.....	12.22	.....	.....	Shedd.
Massive Ore, near Camp Creek	51.13	6.94	none	trace	.....	14.23	.....	.....	Shedd.
Stevens County:									
Capital Mine	59.19	5.80	0.16	0.33	.....	1.85	.....	.....	Shedd.
British Columbia:									
Quatsino Sound Bog Ore	52.0	.....	0.5	.....	.....	.....	.....	.....	Provincial Gov't Lab.
Hesiquoit Harbor, Vancouver Island	56.7	13.1	.....	.....	.....	.....	.....	.....	Provincial Gov't Lab.
Seshart Channel, Vancouver Island	65.0	.....	0.008	0.09	.....	.....	.....	.....	Dr. Wuth, Pittsburg.
Sarita Iron Mine, Vancouver Island	63.7	3.85	trace	0.30	.....	.....	.....	.....	Provincial Gov't Lab.
Texeda Island:									
Texeda Mine	69.85	2.75	trace	0.11	.....	.....	.....	1.05	Fulmer.

of the lower grades of pig iron on the coast is nearly as much as No. 1 iron and therefore there is no consumption of any iron below No. 2 grade. Cheap pig iron of the lower grades would be used if it could be had. Due to the action of these factors the consumption of pig iron could be reasonably expected to reach 1,000,000 tons per year, a small but nevertheless an appreciable amount. Because none of the iron making experiments ever indulged in on the coast have been endowed with sufficient capital and expert management to make a fair test, the problem of manufacturing cost is a hard one to solve. Estimates of the cost of producing iron at Irondale vary from $12 to $19 per ton. It is practically established that the ore from Texeda Island can be mined, loaded and delivered at Irondale for from $1.25 to $2 a ton. The Oregon Iron & Steel Co. operated its Oswego blast furnace successfully for a number of years previous to 1894; but at that time iron was so high on the coast that these operations cannot be compared with present conditions. No. 1 English pig iron is now selling at Seattle for $27 spot, or $24 for delivery in May, 1909. Glengarnock No. 1, Scotch, brings $29. About 18 months ago, English No. 1 was $30 a ton and Glengarnock as high as $39. The market price depends on the price at the English furnaces, the freight rates, the brokers' commissions and the duty. The latter item is now fixed at $4 per ton; while the freight in sailing vesels varies from $3.50 to $7, averaging about $4.25. Therefore any furnace that can produce iron on the north coast for $19 a ton or less can control the market and make money.

The Irondale Furnace Co.

Iron producing is now being started in a modest way by the Irondale Furnace Co., which owns and operates a blast furnace situated at Irondale, near Port Townsend, Wash. The greatest need of the iron producing industry of the northwest today is a more careful and thorough *quantitative* examination of the known bodies of ore, in order that the limits to which the industry may expand can be more definitely determined.

Mining labor on the coast is not above the average in price. White miners underground receive from $3 to $6.50 per day; white laborers, under and above ground, receive from $2.50 to $3.50 per day, and mechanics from $2.75 to $4. Chinese and Japanese are available for all rough, unskilled labor and receive from $1.35 to $2.25 per day.

In preparing the above article, free use was made of the published reports of the provincial mineralogist of British Columbia, the geological surveys of the state of Washington and the United States. Supplementary information was gained by correspondence, interviews, and some personal investigation.

IRON ORE DEPOSITS OF OKLAHOMA.

In a preliminary report on the mineral resources of Oklahoma, just issued by the Oklahoma Geological Survey, iron ore deposits of that state are touched upon by Chas. N. Gould, as follows:

Iron is very widely distributed. There are few rocks anywhere in the world that do not contain it in at least small quantities. It is the great coloring matter of the rocks, and gives rise to the greater part of the reds, yellows, browns, blacks and intermediate tints seen in stone.

In certain localities in Oklahoma the rocks contain relatively large quantities of iron. The shales of the Redbeds of the central and western parts of the state, for instance, sometimes contain as much as 15 or 20 per cent of iron. In certain places among the Redbeds rusty black rocks may be found scattered on the surface which look as if they had been burned. This black rock, usually a sandstone, is really a fair quality of iron ore, and if it can be found in large quantities near cheap fuel, it might pay to smelt it.

Deposits of iron ore have been reported from several parts of eastern Oklahoma. Some of these deposits have been examined and found to be of little or no commercial value.

There are three localities in the state from which large deposits of iron ore are reported, and which may repay investigation, namely, near McAlester, in the Wichita mountains, and in the Arbuckle mountains. For several years there have been persistent rumors to the effect that large deposits of iron ore are found in the mountains south of McAlester. It is stated on good authority that mining experts have examined these deposits in the interests of wealthy corporations and have made extremely favorable reports. The localities where this ore is reported to be found have not been visited by members of the Survey. Specimens reported to have been obtained in these localities which have been examined, appear to be low grade iron ore. At the present time, the Survey does not desire to express an opinion as to the value of the iron ore in this region.

Considerable deposits of high grade iron ore, chiefly magnetite, occur in the Wichita mountains. Large boulders of iron ore are scattered on the surface in several localities, particularly in a region 10 to 15 miles northeast of Mountain Park.

In the Arbuckle region there are extensive iron ore deposits, but so far as known all are in the form of pockets among the limestone.

No estimates have been made of the amount of ore in the mountains nor is it possible to do more than approximate the amount. It is quite probable that the ore in sight, scattered over the hills in widely separated areas, will amount to a number of millions of tons. The greater part of it is in localities difficult of access. Whether or not it will ever be found to be commercially valuable remains to be seen. Fuel is abundant near McAlester and the Arbuckle mountains. If ore is ever found in quantities sufficient to justify development there will be no lack of fuel with which to smelt it.

IRON ORES AND IRON PRODUCTION IN AUSTRALIA.

By J. Findlay.

Whatever the future may hold for Australia in originating manufactures, the raw materials exist in abundance and there seems to be every reason to believe in the permanence and profitableness of iron and steel production in particular. Very little has been done up to the present to utilize the iron ore deposits abounding in this part of the world; and for the most natural reasons. The heavy transportation charges preclude the idea of shipping them to the world's great smelting centers, and the high wages paid for all classes of labor prevents the manufacture of iron on a competitive commercial basis. The true significance of civilization is revealed in the pursuits of the people. In a newly settled country the natural sequence of industries is (a) agricultural and pastoral pursuits; (b) mining industries, and (c) manufacturing processes. Australasia holds an honorable position in the world's trade as a producer of agricultural and mineral wealth, but she is not yet ripe for manufacturing, unless for purely domestic requirements. The country was severely handicapped by being

started as a penal settlement, and its extreme distance from the center of western civilization prevents that free flow of emigration which would go far to open up the country and its wonderful natural resources. Australia is a land teeming with untried potentialities, unexploited possibilities and unexplored possessions. With a population of fifty millions instead of five, there would be a different tale to tell in the Commonwealth Year Book. As it is, the mineral statistics are very creditable. About 20 per cent of the world's gold production, 13 per cent of the total silver production, and 5 per cent of the copper output are accounted for in the returns for Australasia. Notwithstanding the fact that Australia is pre-eminently a pastoral and agricultural country—its farming returns far exceeding the mining results—the mining developments are of great and yearly increasing importance. The Commonwealth Statistician, commenting on the mineral wealth, says: "The large production of gold, silver, copper, tin and lead, the extensive coal deposits, the presence of large quantities of iron ore, and the great variety of minerals found in appreciable quantities, suggest that the future history of mining (in Australia) will, in all probability, be more remarkable than of the past." Or, to view it from another aspect, there is going to be a mighty harvest in the Pacific, and Australia is so situated that the development of trade in the South Seas is bound to bring grist to her mill. Surrounded with islands and trade routes, as she is, and blessed with many desirable physical features, the expansion of her industries is assured; and but for two characteristic drawbacks, viz, the lack of navigable rivers or waters to facilitate internal traffic, and the uncertainty of rainfall, the expansion would be more prompt and more general. The geological formation of the country is remarkable for its simplicity and regularity; the *strike* of the rocks is, with a single exception, coincident with the direction of the mountain chains, from north to south.

Queensland.

Beginning at the north, Queensland possesses vast deposits of iron ores capable of being mined for an indefinite period. At Glassford Creek, near Gladstone, an immense magnetite lode runs through rough basaltic mountains for 90 miles, and carries some excellent magnetic ore. Other deposits of great value are also known to occur in the Moreton district, in the Northumberland Islands, between Mackay and Rockhampton, in the Kangaroo Hills, on the Leichhardt River, and at Cloncurry. The Cloncurry deposits are of large proportions and very rich. Mount Leviathan, Cloncurry, is a mass 200 feet high and a quarter of a mile in diameter, and is composed almost entirely of the purest specular iron ore. In Queensland, as in all the Australian states but one, iron ores are only raised for fluxing purposes, chiefly in connection with gold and copper production.

New South Wales.

New South Wales stands at the head of the states for its enterprise in exploiting the iron industry. The iron ore deposits of this state have been more minutely examined and more fully explored than the deposits of the neighboring states. New South Wales has a most extensive and varied wealth of minerals, and owing to the association of the natural materials for iron and steel production, ores, coal, and limestone, in so many fields, it is probable that it will become the great seat of the iron industry in Australia. The following table, furnished by the government geologist in 1905, gives the description and estimated quantity of iron ore available in various districts in New South Wales:

District.	Description of Ore.	Estimated minimum quantity, in tons.
Breadalbane	Brown ore and hematite	700,000
Cadia, Orange	Specular hematite, magnetite and carbonate ore	39,000,000
Carcoar	Hematite and brown ore	3,500,000
Southern District	Brown ore	1,510,000
Cowra	Magnetic ore	100,000
Goulburn	Brown ore	1,022,000
Gulgong	Magnetic ore	120,000
Woodstock	Brown ore	609,000
Marulan	Brown ore and hematite	40,000
Mudgee	Brown ore with manganese	150,000
Newbridge and Blayney	Brown ore and magnetic ore	150,000
Queanbeyan	Magnetic ore	1,000,000
Rylstone	Brown ore	443,000
Wallerawang	Brown ore	200,000
Williams and Karuah Rivers	Titaniferous magnetic ore	1,973,000
Wingello	Aluminous ore	3,000,000
*Total		53,517,000

*The minimum total is here estimated at 53,500,000 tons, but the probable yield for the whole of New South Wales has since been estimated at 200,000,000 tons.

The Cadia ironstone beds have proved the most extensive yet examined. The report says: "The ore comprises two classes, oxidized and unoxidized, the former of which consists of hematite and magnetite, and contains from 57 per cent to 61 per cent of metallic iron. A large proportion is suitable for the manufacture of steel by the acid Bessemer and other acid processes, and compares favorably with some of the best American ores."

At Carcoar the deposits include brown ore, hematite and magnetite, averaging 52.67 per cent metallic iron. Deposits of chrome ore are also found along with phosphoric ores suitable for the manufacture of high class steel. Samples of ores from the Bathurst district and Lithgow valley yielded from 48.83 per cent to 61.30 per cent metallic iron. Geothite occurs in very extensive deposits in the Blue Mountains and Macquarrie ranges, which have only been partially explored. Analyses of samples showed from 42.69 to 64.48 per cent of the metal.

Victoria.

Up to 1906 only 6,000 tons of iron ore are recorded as having been produced in Victoria. Supplies have been located at various centers, particularly at Nowa-Nowa, in the Gippsland district, and at Dookie. The secretary of mines in his report states that "without special assistance to the industry there does not seem to be any prospect of the deposits being cheaply worked."

Tasmania.

The existence of large quantities of iron ore in Tasmania was noted as far back as 1822, when the surveyor general alluded to the "surprising abundance of iron within a few miles of Launceston." A company known as the Tasmanian Charcoal Iron Co. was formed to work these deposits and commenced operations in 1876. The presence of chromium proved a difficulty, and the works were soon abandoned. In the vicinity of the Blythe and Gawler rivers, extensive deposits of specular iron are also found. The Blythe river ironstone beds have been reported on as follows:

"The river cuts through an outcrop of hematite ore about six miles from its mouth. The bed dips to the southeast and appears to be conformable with the enclosing strata. Its thickness is variable with a maximum of 150 feet. Levels driven from the hillside have disclosed good ore at some depth below the out-

crop of over 80 feet in thickness. The iron contents range from 46 per cent to 68 per cent, and silica from 1 per cent to 34 per cent with traces of sulphur and up to 0.09 of phosphorus. The ore could be worked over a considerable area." Several valuable deposits occur also in the neighborhood of Hobart and on the West Coast, but no practical attempt has been made to quarry them, or to use them in any way.

South Australia.

South Australia is the vineyard of the commonwealth, but its mineral wealth is equally important. It possesses rich deposits of iron ore, some of which are practically inexhaustible. Here, as elsewhere, in these states, iron ore is chiefly raised for fluxing purposes, the rich oxides being employed for the purification of coal gas, and in the chemical industries. The best known deposit in South Australia is the Iron Knob—a veritable hill of iron of high metallic content. This property has been leased by the Broken Hill Proprietary Co., the ore being transported to the smelting works at Port Pirie. Great tracts of this state remain to be explored; it forms the central strip of the Australian continent and touches the borders of four of the states.

Western Australia.

In this state, as in Victoria, gold mining quite overshadows all other mining ventures. Several very rich deposits of high grade iron ore exist, but owing to their geographical position the most extensive fields are practically unexploited, the production of the state being confined to that needed for fluxing at the smelting furnaces.

New Zealand.

The Australasian mineral statistics usually include New Zealand returns. A very valuable deposit (limonite and glanconite) occurs along the western slope of Mount Royal, Otago. The Parapara river district has a complete outfit in the shape of large bituminous coal measures, ample water supply, nearly pure crystalline limestone quarries and a main deposit of iron ore estaimated at 60,000,000 tons. Another feature of the iron possibilities of New Zealand is the extensive ironsand deposits at various parts of the coast, that of Taranaki being the best known. Many experiments have been made with the ironsand to determine the best method of smelting. Used with clay and molded into blocks or briquettes, it may be readily smelted in the blast furnace, and the iron produced is of excellent quality, suitable for steel making processes. No attempt has been made, however, to utilize these vast ironsand deposits on a commercial scale.

Some Failures.

In New South Wales several heroic attempts have been made to utilize the abundant and excellent ores, fuels and fluxes, and establish the iron industry on a commercial basis. The first plant was erected at Fitzroy, near Mittagong, in 1852. Smelting operations were carried on intermittently for three years and then, for lack of capital, or owing to the distrust of the English syndicate interested in the enterprise, the works closed down. In 1864, another attempt was made to get this plant going. The works were re-opened, and during the two years following good pioneer work in pig iron production demonstrated beyond doubt the feasibility of starting the iron industry in Australia on its own merits. It is worthy of note that during this period large contracts for gas and soil pipes, bridge cylinders and girders, and many other castings were made from direct metal, the iron being taken straight from the blast-furnace to the molds. The ore deposits of the Mittagong district are chiefly brown ore, or limonite, which owe their origin to chalybeate springs. Coal seams underlie the deposits and limestone is obtainable within easy distance. Some samples of ore, coal and limestone from this district, with pig iron and castings manufactured therefrom, obtained a first award at the mining exhibition in London. "Fitzroy iron" is a cherished name amongst the foundrymen in Australia. The iron was undoubtedly good, but the well known process of "dumping" made it impossible to continue the competition with imported brands. In 1875, another plant was put down at Eskbank, near Lithgow, but a similar fate befell the project, and again the establishing of this industry suffered a postponement.

The Latest Attempt.

The latest attempt to manufacture iron for Australia's needs from local ores was due to the initiative of William Sandford, the proprietor of large rolling mills at Lithgow. He entered into an agreement with the government to supply all pig iron, rolled steel and iron supplies, to the usual specifications, for a period of seven years. The government guarantee gave the bright prospect of permanently establishing an iron industry in Australia. At the same time, Mr. Sandford was fully alive to the fact that iron and steel making is one of the progressive industries where the utilization of every scientific and economic advantage marks the stages on the road to success. The erection of the blast furnace (capacity, 100 tons per day), and two Seimens open-hearth furnaces (capacity, 30 tons of steel per day, for each furnace), was a good augury that business was meant on this occasion. The seven years contract which was the main factor in starting the enterprise, has five more years to run, and with the addition of a bonus on all iron produced, promised to take place from September 1908, and the advantage of 12½ per cent, which is the duty on imported iron and steel, the prospects are very rosy for the permanent success of the enterprise. Although the firm has lately changed hands, being now under the management of G. and C. Hoskins, engineers and pipe founders, Sydney, the continuity of the contract has not been interfered with, and later concessions have helped the growth of the industry in their hands. Nevertheless it must be many long years before the Australian commonwealth can enter the list of competitors in the production of iron and steel for the markets of the world. The present objective is to foster the industry for domestic uses only, but as the irresistible tide of national development rises to higher levels, so must the industries expand to meet the national needs. And no country in the world possesses the room for expansion that we have in Australia where the population figures out at something less than two persons per square mile. The mastery of the Pacific is on the international agenda—a question for future diplomacy. There are many in this country who believe industrial and commercial agressiveness will go far in deciding the question; hence the anxiety to succeed in building up the iron industry, which is the basis of defense and manufactures.

IRON ORE DEPOSITS OF THE UNITED STATES.

In the report of the minerals section made to the National Conservation Commission in Washington, Dec. 9, by Senator Flint, of California, in the absence of Representative John Dalzell, the chairman of this section, the following reference was made to iron ore:

The data concerning our iron ore supplies, while less complete than that concerning the coal, are nevertheless sufficiently definite to yield results of decided value. These estimates, based upon data gathered from every available source, indicate that we have in sight of high-grade iron ores, or such as are available for use under present economic conditions, 3,840,000,000 tons, of which nearly two-thirds is located in the Lake Superior district.

In addition to these, the final estimate of low-grade iron ores, which are not available for use under existing conditions, shows there are about 59 billion tons ditributed through the iron producing districts. At the present increasing rate of consumption, it is estimated that these high-grade iron ores will have been largely consumed by the middle of the present century; while the supplies of high-grade available coal may be extended to near the middle of the next century.

YEAR OF SUSPENSE ENDS WITH CONFIDENT EXPECTATIONS

EVENTS OF THE MARKET IN THE CHICAGO DISTRICT

Three Buying Movements in Pig Iron—Only Moderate Buying by Railroads—Interesting Features of the Scrap Market

By Oliver J. Abell.

The passing of the year 1908 will be viewed with a feeling of suspense relieved. Those who have not struggled through the year under the burden of financial stress have been scarcely less enviable in their chafing against the oppressive inertness of the market. Beginning with the hope that looked forward to January, 1908, as the certain day of advent for normal conditions returning, this past year will probably be recalled as one of more prophecies gone wrong and hopes deferred than any previous twelvemonth within remembrance. Sentiment, by which transactions are undeniably controlled, and the general tone of the market, here as elsewhere, were influenced pre-eminently by the effort to control prices through strength of cooperation. With the records of the year before us, partisans to both sides of the question may be found in sufficient numbers to command respect.

The year offers no record-breaking contrasts with previous periods, while tonnages and expenditures require only modest terms for description, but it can be recorded that we have passed from a minimum of business in the first three months of the year to a degree of activity in the last three months which compares not unfavorably with normal conditions. In addition industry finds itself prepared to realize the optimistic hopes called forth by the prospect for the coming year. One interesting development has been brought out as a result of the contrary policies pursued by the so-called independent interests on the one hand and the subsidiary and allied companies of the Steel Corporation on the other. It has been made apparent that while the balance of power wavered long before establishing itself, there still remains by a small margin, sufficient independent capacity to make competition the arbiter of prices, and the action of the independent capacity is a large influence in the movement of prices.

The Pig Iron Market.

Just what the trend of prices and the movement of various products has been throughout the year under this new influence, offers an interesting study. Pig iron has always been known as a weak member. The past year proved no exception to the rule, despite unusual effort exerted in this direction by those wishing to prevent a too wide spread between pig iron prices and the price of crude steel. We find a gradual decrease in the price of both northern and southern irons from an average of $18.25 for the former, and $17.50 for the latter in January, down to $17 and $16 respectively in May. Southern iron in the first few months was noticeably weaker than local northern iron, and the natural differential favoring the northern product was increased. The downward tendency of southern iron received its greater impetus from the sale of a lot of 50,000 tons of southern iron, quietly made in February, at a dollar below the market. In June, when the price was weak at $12 Birmingham, and one of the southern furnace companies in particular was carrying large stocks of iron, a similar sale, in larger quantity, also a dollar below the current market, or at $11 Birmingham, was carried through. Most of the southern producers joined in this selling movement, with the result that a total of over 150,000 tons of southern iron was placed. In contrast to the February transaction, the sale in June strengthened the situation by disposing of the large tonnage held in stock and by selling up a considerable part of the capacity of the furnaces in blast, both of which tonnages had prior to that time menaced the market stability. The price advanced during the following month and for southern iron continued to do so throughout the balance of the year. The course of local northern iron was more unusual. While southern producers had been selling, but little northern iron was being moved and while the southern situation gradually became stronger, the northern market remained weak with declining prices through October. As a result, the unusual situation arose where local iron was selling from 50 cents to $1 below the southern price and southern furnaces were practically unable to sell in Chicago. The cause of this price differential which ordinarily need not have existed, however weak the demand for iron, emanated from an intrusion into this territory by Ohio furnaces by which iron was sold as low as $16.20 delivered here.

Third Buying Movement.

About the time of the November elections, the third pig iron buying movement of the year developed. The lowest price of the year for northern iron prevailed and better than $15.60 at the furnace was done. Since that time, when a great many thousand tons were sold, prices have gradually grown firmer and northern iron has become established again on an equal basis with southern iron delivered in Chicago. In the three buying movements thus recorded, nearly all of the iron sold during the year was purchased. In the intervals between, the market was exceedingly dull, transactions being small and scattered. With regard to pig iron the effort to control prices was almost entirely without result.

The price changes in finished materials were, of course, not local in their origin, and so far as the tonnage movement of material was concerned, the reductions had little apparent effect directly attributable to them. This is with two possible exceptions. The price of iron bars was reduced at the beginning of the year from $1.75 Chicago to $1.55 without affecting the market, but when announcement was made in February that bars would be again advanced $2 a ton, a large tonnage was contracted for. Subsequently the price was reduced to $1.50. It was also noticeable that the reduction in the various forms of steel announced June 11 was followed by a distinct lull in business.

Until the middle of June there was no evidence that the buying of steel bars by the agricultural implement interests would partake of any greater

activity than had characterized the general market up to that time. In June, however, reports made apparent the excellent prospect for good crops, to which incentive was added the reduction in price of $4 a ton, so that the latter part of June, July and the forepart of August saw as heavy contracting for steel bars as is usually witnessed in this market, an unusually large proportion of the business going to the leading interest. Quite as gratifying as the volume of original contracting has been the active specifying throughout the remainder of the year. Since July 1, the steel bar mills in this territory, particularly those of the leading interest at Bay View, have been operated well up to capacity.

Structural Steel.

The structural steel market for the year has been of more than passing interest and the price conflict has been waged perhaps more strenuously in connection with the fabrication of building steel than in any other direction. The large number of small fabricating shops offered a situation very susceptible to pressure. Under these conditions it is not surprising that the price of fabricated steel was gradually reduced in the scramble for contracts to a point where no profit was possible. Prices were made as low as $42 a ton for erected material, despite the fact that there were no reductions on plain structurals other than that of $2 a ton in June. Builders continually delayed the placing of contracts in attempting to draw out lower prices and at times there have been as much as 75,000 tons pending. The low prices made resulted in the contracting for a larger tonnage of steel in 1908 than in 1907 in contrast to reduced tonnage in other lines, which comparison has been offered in argument against the general maintenance of price policy. Although a gradual improvement has been apparent in the last three or four months of the year, prices are still on a lower level than the schedule of fabricating rates would normally establish. To make these extremely low prices, required, as a matter of fact, some co-operation on the part of structural mills and these mills contributed their share to the general undercurrent of surreptitious price shading in many directions. The year 1908 will stand out as especially prolific in quiet concessions.

A total of about 190,000 tons of steel has been figured upon in this territory, of which 170,000 tons has been built. The railroads have been large contributors to this tonnage, particularly the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul roads. Of the total tonnage placed, fully 100,000 tons came from the western railroads. Among the important structural projects of the year were the Chicago & Northwestern depot and track elevation, requiring 28,000 tons; the La-Salle hotel, calling for 8,000 tons; the Peoples' Gas & Coke building, 9,500 tons; Mississippi River bridges at St. Louis and Keithsburg, 15,000 tons; the Corn Products plant, 4,200 tons; Denver railroad viaduct, 4,000 tons; Drake hotel, 5,334 tons; City Hall, 12,000 tons; Anaconda Smelter, 3,000 tons; Harriman lines, 10,000 tons; the Bettendorf Axle Co., for the construction of steel under-frames, 35,000 tons, and a Milwaukee viaduct, 2,550 tons.

Railroad Buying.

The turning point toward better things may be credited to the railroads, and can be traced to the preparations inaugurated about the first of July by the western railroads for the repair of their equipment for the handling of the fall harvests. It could not be expected that the effect of this would be plainly apparent at once, with so much foundry, mill and repair-shop capacity idle. As a matter of fact, however, railroad repairs gradually brought into service a large part of the capacity of their own repair shops, as well as that of outside manufacturing plants. In August the railroads began buying new equipment that required the purchase in the market of finished steel from the mills. Among the first of such orders was that of the Chicago & Alton railroad for 2,000 steel cars, placed with the Standard Steel Car Co. The immediate contracting for 20,000 tons of steel shapes and plates resulted. About the middle of September, the Chicago, Milwaukee & St. Paul railroad ordered 5,000 steel under-frame cars, which, added to its order for 2,500 similar cars in March, brought into the market a demand for fully 35,000 tons of steel. In September, October and November, the buying of cars and locomotives by western railroads was very general.

The lack of railroad buying was felt most severely, however, in the matter of steel rails. Early in the year it was apparent that none of the roads would purchase heavily, and the contracting of the Great Northern railway in March for 60,000 tons, the New York Central lines in April for 80,000 tons, and the Chicago, Burlington & Quincy in December for 40,000 tons were practically the only large transactions of the year. Smaller purchases in 5,000 and 10,000 ton lots were infrequent, and well scattered. At one time, it became a problem at the local mill of the leading interest to provide tonnage for the continued operation of its plant—a situation almost unprecedented.

Old Material.

One of the most interesting phases of the market has been the control of scrap. Throughout the first half of the year the scrap market was quite as weak and lifeless as any other branch. In June, however, without apparent reason, the prices began to advance and continued to do so throughout the rest of the year, recording an increase from May until December of $4.75 a ton on No. 1 wrought iron, and $4 on re-rolling rails. The advance was brought about in the face of a very limited demand from consumers, with the exception of re-rolling rails, and in spite of normally heavy offerings of scrap by the railroads, because the dealers in old material in this territory were financially strong enough to outbid consumers in buying from railroad lists, and were also able to place this scrap in their yards when they could not sell at a profit. In the case of re-rolling rails, Chicago in the past year has developed into a market of considerable importance. Four re-rolling mills, the Inter-State Iron & Steel Co., the Calumet Steel Co., Inland Steel Co., and Deering Works of the International Harvester Co., covered their very considerable requirements in Chicago, in addition to which fully 25,000 tons was diverted to Moline for the mill of the Republic Iron & Steel Co. As a result of the activity of the dealers, some 250,000 tons of scrap was accumulated in local yards, which was practically their full capacity.

In November and December, it became apparent that the market had not developed sufficiently to consume the accumulated scrap at the prices to which the market level had been raised. Unable to store material, dealers found it necessary to sell to consumers at from 50 cents to $1 lower than they were able to buy from railroads, in order to move their purchases promptly. An added reason for the large accumulation of scrap in this market was the discounting of the requirements of the steel plant at Gary, Ind. It is still an open question, however, just how much scrap, and how often, the Steel Corporation will buy in the market, which uncer-

tainty has not added strength to the situation.

The amount of scrap to be used in making its steel is quite flexible, and the minimum percentage can be brought down to a point little, if any, in excess of what the Steel Corporation can supply Gary from its own plants. It is also understood that the Gary plant will have its own scrap handling yard, so that material may be obtained direct from the railroads, and as it will be at least three months before such steel will be required at Gary, the stock of scrap which the Steel Corporation has already gathered can be considerably increased.

Wire Products.

The trade in various wire products has stood out uniquely from the rest of the market. Throughout the year these materials, which more than any other class of product go directly to the farmer, have received the benefit of the prosperity which the agricultural communities have enjoyed as a whole. Although reduced in volume to as low a point as 50 per cent of normal, the wire trade has continually been in advance of the remainder of the market, and has been practically the only class of material on which reductions have not been made. From midsummer the volume of business has increased rapidly, and November stands out as the second largest month in the history of the American Steel & Wire Co. There is reason to believe that Feb. 1 will see the full capacity of the leading interest in operation.

New Construction.

Financial conditions did not permit of much new construction during the year. Most of that which might be recorded is simply the completion of work undertaken during 1907. At Gary the eight furnaces under construction have progressed to a point where two have been blown in during the past month, and all of them are at some stage of erection. Of the 56 open-hearth furnaces authorized, 28, included in open-hearth buildings Nos. 3 and 4, are about ready for firing. The foundations are in for the third set of 14, and the steel has been ordered for the third building. The rail and billet mills are practically completed, although it is not likely that they will be put in operation before the first of April. At the South Works, 26 new open-hearth furnaces have been completed, and more than half of them have been put in operation. At Joliet, the new Koppers coke ovens have been in operation for several months, although two of the batteries are not completed. The Minnesota Steel Co.'s plant at Duluth has progressed but little during the year, and operations have been confined almost entirely to railroad, dock and surface work.

Among the independent interests, the Inland Steel Co. has put into operation its merchant bar mill, a 36-inch blooming mill, a 24-inch sheet bar mill, a new hot metal tunnel and has added eight 500-horsepower Stirling boilers to its steam plant. The Iron Products Co., of Joliet, has rolled its first bars, the Riverdale Iron & Steel Co., at Riverdale, has completed its mill and the International Harvester Co. is now erecting a cold-rolled shafting department at its Deering works. Among the jobbers the completion of the immense new warehouses of Jos. T. Ryerson & Sons is a notable achievement of the year and quite as interesting to the trade was the absorption of Kelly, Maus & Co. by the Scully Iron & Steel Co. The building of the new foundry for the Featherstone Foundry & Machine Co., now in progress, is the most interesting addition to the foundry plants of Chicago.

The Future.

The end of the year finds every branch of industry eager for the year ahead. Where in December of 1907 there was hope without assurance, there is this year a hope based on substantial prospects. A great deal of interest attaches to the beginning of operations at Gary, with particular regard to their effect upon the western market. It is believed that the demands of the west even before the expiration of 1909 will have regained that volume to provide for which Gary is being built, and that the new capacity will be entirely absorbed without any disturbance of present conditions.

RUSSIAN IRON AND STEEL STATISTICS.

The American Iron and Steel Association gives the following statistics of the production of iron ore, pig iron, steel ingots and castings, and steel rails in Russia in 1907 and immediately preceding years. The figures are chiefly official.

Iron Ore.—The production of iron ore in Russia in 1907, exclusive of the manganese ore exported from Poti, is reported to have amounted to 4,227,419 metric tons. In 1906 the production was 3,873,356 tons, in 1905 it was 4,942,182 tons, and in 1904 it was 5,160,990 tons. The decrease in production from 1904 to 1907 amounted to 933,571 tons. The exports of manganese ore from Poti amounted in 1907 to 881,322 tons, against 464,016 tons in 1906.

Exports of Iron Ore.—The exports of iron ore from South Russia to Germany in 1907 amounted to 1,613,000 metric tons, as compared with 535,000 tons in 1906, and 373,000 tons in 1905.

Pig Iron.—The production of pig iron in Russia in 1907 amounted to 2,820,604 metric tons, as compared with 2,691,606 tons in 1906, 2,713,674 tons in 1905, and 2,950,651 tons in 1904. The decrease in the four years was 130,047 tons. Castings made direct from the furnace are included.

Steel Rails.—The production of steel rails in Russia in 1907 amounted to 311,806 metric tons, against 271,739 tons in 1906, 358,499 tons in 1905, and 401,668 tons in 1904.

Average Monthly Prices, Chicago Delivery, 1908.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Northern No. 2 Foundry	$18.24	$17.87	$17.42	$17.21	$17.00	$17.31	$17.00	$17.00	$16.75	$16.50	$16.75	$17.35
Southern No. 2 Foundry	17.55	17.35	17.10	16.35	15.97	16.22	15.97	16.47	16.85	16.85	17.22	17.35
Malleable Bessemer	18.25	18.00	17.50	17.30	17.00	17.31	17.00	17.00	16.75	16.50	16.75	17.35
Lake Superior Charcoal	22.80	21.50	21.50	21.10	19.87	19.50	19.50	19.50	19.50	19.50	19.50	19.50
Forging Billets	33.00	33.00	33.00	33.00	33.00	30.75	28.50	28.50	28.50	28.50	28.50	28 50
Bar Iron	1.58c	1.55c	1.55c	1.55c	1.55c	1.50c	1.50c	1.50c	1.50c	1.50c	1.50c	1.50c
Steel Bars	1.78c	1.78c	1.78c	1.78c	1.78c	1.58c	1.58c	1.58c	1.58c	1.58c	1.58c	1.58c
Small Steel Angles (less than 3 x 3 inches)	1.88c	1.88c	1.88c	1.88c	1.88c	1.68c	1.68c	1.68c	1.68c	1.68c	1.68c	1.68c
Black Sheets No. 28	2.68c	2.68c	2.68c	2.68c	2.68c	2.68c	2.68c	2.68c	2.68c	2.68c	2.68c	2.68c
Structural Steel	1.88c	1.88c	1.88c	1.88c	1.88c	1.83c	1.78c	1.78c	1.78c	1.78c	1.78c	1.78c
Plates	1.88c	1.88c	1.88c	1.88c	1.88c	1.83c	1.78c	1.78c	1.78c	1.78c	1.78c	1.78c
Smooth Finished Machinery Steel	2.18c	2.18c	2.18c	2.18c	2.18c	1.83c	1.83c	1.83c	1.83c	1.83c	1.83c	1.83c
Wire Nails	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23	$ 2.23
No. 1 Wrought Scrap	11.40	12.50	11.25	11.00	11.00	11.81	12.05	12.75	13.44	13.55	14.69	14.75
Re-rolling Rails	12.30	13.00	12.19	12.75	13.19	14.00	14.45	15.62	16.00	15.70	16.94	17.25

LOOKING FORWARD WITH CONFIDENCE

STORY OF A RATHER UNHAPPY YEAR IN THE PITTSBURG DISTRICT

Price Maintenance Policy Was an Important Factor in Preventing Greater Demoralization — Tin Plate Suffered Less Seriously Than Other Lines—New Construction

By Chas. J. Stark.

The eyes of the iron and steel maker are turned towards the new year. In the period stretching out before him, he is placing strong reliance for a consistent advance of the market toward its former plane of activity. His faith in the future is manifestly stronger, his tone of confidence more assured. Measured by the contrast of present conditions with those existing one year ago, his attitude of reasonable optimism appears not unsound.

The past year has been largely formulative in its effect. Within it has neither the point of lowest decline nor the goal of normal trade been reached. The past 12 months have played their part and an important one, nevertheless. One year ago, uncertainty and lack of confidence were apparent sources of weakness in the market structure. Today many of the disturbing elements that had marked their effect upon general business conditions have been eliminated. Universally a new note has appeared in commercial affairs and though the atmosphere is still not wholly clarified, a more accurate view of the trend of events is now afforded. The closing year has provided the opportunity to bring about this process of improvement.

Strong Policies Necessary.

By force of the extremities of the case, the iron and steel industry has presented some unusual developments. Brought abruptly from a period of high prosperity to a time of practical business stagnation, there has been need of firm and decisive policies in directing the readjustment of the equilibrium of trade. Many of the effects arising from this readjustment, were felt and assimilated in the past year.

The policy of price maintenance in which the leading iron and steel interests have co-operated for the common support of the industry, was fully applied during the year. For the first five months, prices were consistently upheld, affording the opportunity to patrons to dispose of stocks without financial loss. As the midyear for new contracting approached, certain interests showed impatience at the slow recovery of business and threatened to precipitate some demoralization of the market. The general reductions followed in June.

The lower level of prices had a salutary effect in a degree and brought forth much of the withheld trade. The cautious attitude of buyers arising from a lack of confidence in the stability of the market and from an uncertainty as to future consumptive demand still remained apparent, however, and continued so throughout the year. The settlement of the presidential problem and of other disquieting influences gradually strengthened and improved sentiment and left it favorable at the start of the new year.

In the matter of prices, though probably not significant, it is an interesting observation that those steel products which were not subject to the general reductions in June were much exposed to cutting of quotations both before and after this important turn of the situation. This action was confined largely to some independent interests and was particularly true in sheets and tin plate, in which official reductions had already been made in January. The rerolling mills were aggressive in the light rail market and the makers rolling from billets were forced to meet this competition to obtain tonnage. Shading of plate prices was quite frequent.

Mill Operations Increased.

The Pittsburg mills generally enjoyed more consistent operating schedules in the last half than during the first six months. At times, particularly in wire products, merchant pipe and tin plate, plants were run closely to normal. The year's trade in these products was nearest the mark set by prosperous periods and was correspondingly gratifying to manufacturers in these lines. The rail mills ran the lightest, but the record of the large plate and structural mills was only moderately better. In January, 1908, many of the leading steel works in this district were running upon less than a 40 per cent basis. At the present time, these mills are working at approximately 60 per cent of capacity or better, some even reaching as high as 90 per cent.

The year has been a severe one for iron and steel makers from the standpoint of fixed charges because of the restricted operations and by reason of the idle and useless capacity under the conditions in force. Emergency funds were called upon in some cases and the wisdom of far-sighted policies with respect to the division of earnings in full years was reflected. It is a noteworthy fact, however, that few companies were so seriously embarrassed as to bring disaster upon themselves. The difficulties of the Westinghouse companies were successfully overcome and these corporations refinanced upon a sound basis. The receivership of the Westinghouse Machine Co. was terminated in March and that of the Westinghouse Electric & Mfg. Co. in November after a thorough and elaborate plan of reorganization had been worked out.

Planning for Future.

Construction work in the Pittsburg district was not extensive for the reason that the demand for additional capacity to meet consumption was not present, but undertakings that had already been inaugurated along the line of settled policies for the future were advanced or completed in the year. The Carnegie Steel Co., in its effort to centralize its various units of production at the Duquesne, Ohio., Homestead and Clairton works lying outside the city, made progress in the primary capacity required for this plan, namely in its blast and open-hearth furnace building. The Ohio and Duquesne works improvements, consisting of large extensions of pig iron and steel making equipment which are steadily going ahead, are examples of this purpose. The gradual withdrawal from its scattered small mills located within the corporate limits of Pittsburg and of the corresponding increase of the size and importance of its outlying plants form the logical result of a desire to effect the highest economy in production costs and to escape the large rentals and taxation for leased property upon which the city levies apply. Future developments with relation to the new construction and rearrangement of the company's works activities in this district are expected to follow this general policy.

The Pittsburg Steel Co. was a notable acquisition to the ranks of the larger

steel makers in the year. This company completed the extensions of its Monessen works, becoming a maker of its own steel requirements and a heavy consumer of pig iron. The largest single pig iron transaction of the past several years in this territory, involving about 360,000 tons of basic metal, was made directly bearing upon the company's new position. The Pittsburg Steel Co. had formerly been a prominent maker of wire products and its works enlargement has added greatly to its importance in the general market. Of the other important projected plant extensions, that of the Jones & Laughlin Steel Co. for a complete new works at Aliquippa was not actively pushed during 1908.

Pig Iron.

The expected result of the business depression was a year of sharp decline in pig iron consumption, attended by restricted production and extremely low prices. During the first half of the year, makers of merchant pig iron bent their energies toward concerted efforts for the holding of a firm market. Several meetings were held, resulting in the adoption of the interesting expedient of fixing a delivered price of $17 plus switching charges for No. 2 foundry, instead of the accustomed Shenango and Mahoning valleys basing method. Several interests declined to co-operate in this plan, causing its failure and the prevalence of an open market. This condition depressed prices until the low point was touched in October, when No. 2 foundry sold down to near $14 valley, basic $13.85 valley and Bessemer to $14.45 valley, the latter being the lowest quotation for this grade since July, 1905. The reduction of 50 cents in ore prices accompanied this decline, extending over 10 months.

The year was not without several relatively brisk buying movements. In May, melters came into the market rather freely, taking advantage of the low level for their last half needs. The market showed no stiffening qualities from this support. The main activity in contracting appeared immediately preceding and following the presidential election, and the market advanced from $1.50 to $2 a ton.

The Bessemer demand throughout 1908 was not heavy, reflecting the reduced melt of such large consumers as the Cambria Steel Co., and Youngstown Sheet & Tube Co., which in prosperous periods are usually heavy buyers for their requirements in excess of their own furnace production. The latter company toward the close of the year completed and started its two new blast furnaces, bringing itself more closely to a self-contained position, so that it is not likely to be a large buyer in the near future. With the encroachment of open-hearth practice upon the leadership of the Bessemer process in steel-making, the future market for Bessemer pig iron is expected gradually to decline in favor of basic. It is believed this condition will readily adjust itself, however, by some furnaces changing to the more sought grade because of the limited known supply of Bessemer ores, leaving only sufficient capacity to meet the fixed demand.

In basic, several important long-term contracts were closed, including that by the Pittsburg Steel Co. with the Penn Iron & Coal Co. operating the Canal Dover furnace, for 6,000 tons monthly for practically five years beginning Jan. 1, or an aggregate of 360,000 tons and that by the Page Woven Wire Fence Co., with W. P. Snyder & Co. for 2,500 tons monthly for three years, beginning July 1, 1908. The price arrangement of the contract placed by the Pittsburg Steel Co. is interesting. A 7 per cent profit to the furnace is provided when iron is selling below $15, and this advances 1 per cent for each 50 cent raise in the market until the maximum of $17 iron and 12 per cent profit is reached. The completion this year of the large new steel works at Monessen by the Pittsburg Steel Co. brought another large buyer of basic into this market, as this company had formerly not been a heavy maker of steel and had purchased its billets from the Carnegie Steel Co.

Merchant pig iron in the valleys and territory contiguous to the Pittsburg market scaled down at the opening of the year in accordance with the high demand, and gradually advanced movement. Early in the year, but four merchant stacks out of 18 in the valley and including Dover, were in blast. This condition steadily improved until at one time in the last quarter but four furnaces out of 17 were idle, the total capacity having been reduced by the advancement of No. 2 Shenango. Many furnace interests grasped the dull period as an opportunity for making long-needed repairs and relining and rebuilding operations were active.

The concession granted by the ore interests in the adoption the past season of a new form of contract, involving new penalties to be paid where the iron content falls below the guarantee, is of much value to those furnaces without their own ore supply, since it places them in a more favorable competitive position with relation to the makers controlling mines. The rebates allowed for a decline in iron content below the guarantee are much larger than the bonus to be paid the shippers if the base is exceeded.

AVERAGE MONTHLY PRICES OF IRON AND STEEL PRODUCTS, PITTSBURG, DURING 1908.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bessemer Pig Iron	$19.00	$17.90	$17.86	$17.49	$16 92	$16.90	$16.73	$16.11	$15.90	$15.48	$16.74	$17.40
Basic Pig Iron	17.25	16.90	16.90	16.50	16.40	16.25	16.00	15.90	15.50	15.10	16.40	16.40
No. 2 Foundry	17.25	16.90	16.60	16.00	15.40	16.25	16.00	15.90	15.50	15.10	16.40	16.40
Gray Forge Iron	16.25	15.90	15.90	15.25	15.00	14.90	14.90	14.90	14.65	14.25	15.25	15.25
Ferro-Manganese	49.00	48.00	46.00	44.00	45.00	46.00	45.50	45.50	45.00	45.00	45.00	46.50
Bessemer Billets	28.00	28.00	28.00	28.00	28.00	26.50	25.00	25.00	25.00	25.00	25.00	25.00
Rails (Standards)	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
Beams and Channels (15" and under)	1.70c	1.70c	1.70c	1.70c	1.70c	1.65c	1.60c	1.60c	1.60c	1.60c	1.60c	1.60c
Tank Plates	1.70	1.70	1.70	1.70	1.70	1.65	1.60	1.60	1.60	1.60	1.60	1.60
Steel Bars	1.60	1.60	1.60	1.60	1.60	1.50	1.40	1.40	1.40	1.40	1.40	1.40
Bar Iron	1.40	1.50	1.50	1.50	1.50	1.45	1.40	1.40	1.40	1.40	1.45	1.50
Sheets, (28 gage black)	$3.55	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50
Sheets (28 gage galvanized)	3.65	3.55	3.55	3.55	3.55	3.55	3 55	3 55	3.55	3.55	3.55	3.55
Tin Plate	3.80	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Wire Nails (jobbers)	2.05	2.05	2.05	2.05	2.05	2.00	1.95	1.95	1.95	1.95	1.95	1.95
Merchant Pipe (steel, ¾ to 6", black)	54.00	54.00	54 00	54.00	54.00	52 00	50 00	50.00	50.00	50.00	50.00	50.00
Merchant Pipe (iron, ¾ to 6", black)	58 00	58.00	58.00	58.00	58.00	56 00	54 00	54 00	54.00	54.00	54.00	54.00
Boiler Tubes (steel, 2¼" to 5")	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70 00	70 00	70 00	70 00	70 00
Boiler Tubes (iron, 2¼" to 5")	96.00	96 00	96.00	96.00	96 00	96 00	96 00	96.00	96 00	96.00	96.00	96 00
Hoops	2.00	2.00	2.00	2.00	2.00	1.90	1.80	1.80	1.80	1.80	1.80	1.80
Furnace Coke.. (spot)	1.80	1.75	1.70	1.65	1.65	1.65	1.65	1.65	1.65	1.70	1.75	1.80
Foundry Coke (spot)	2.40	2.35	2.20	2.10	2.00	2.00	2.05	2.00	2.00	2.00	2.10	2.15
Heavy Melting Steel	13.25	13.50	13.25	12.75	12.75	13.00	14.25	14.75	14.65	15.00	15.75	16.25

The average monthly selling prices of Bessemer pig iron at Pittsburg points throughout the year, which form the basis for the adjustment of numerous contracts in pig iron, semi-finished steel and other materials, are shown in the accompanying table.

Semi-Finished Steel.

The year 1908 has tended to emphasize the goal towards which most makers of finished steel products are striving, that of a self-contained position in their operations. The plant of eight 60-ton basic open-hearth furnaces at the Monessen, Pa., works of the Pittsburg Steel Co., is a notable example of this movement. The Pittsburg Steel Co. has been a heavy buyer of billets, but its long-term contract with the Carnegie Steel Co. expired July 1, 1908, at about the time of the completion of its new steel works. Since then it has only been an occasional buyer of special lots. The Page Woven Wire Fence Co. also completed a basic open-hearth 50-ton furnace at its Monessen works.

A purpose of the large steel makrs to constantly broaden the field of consumption for their steel was illustrated in the year by the acquirement of the plant of the Schoen Steel Wheel Co. at McKees Rocks, Pa., by the Carnegie Steel Co., and of the wire plant of the Morgan Spring Co., at Struthers, O., by the Youngstown Sheet & Tube Co.

Prices have been well maintained, but an effort at equalizing freight charges among consumers of billets and sheet bars within and outside the Pittsburg district was made, by an arrangement now in effect to divide the freight to points where the haulage charge is more than $1 and not exceeding $3 from the Pittsburg mill. Where the freight is more than 50 cents and less than $1, billets are $25.50 delivered and sheet bars $27.50 delivered.

Merchant Bars.

Of a normal demand for steel bar mill products of about 4,000,000 tons, it is estimated that the output in 1908 will be less than 2,000,000 tons. The main buying movement of the year came immediately after the official reduction from 1.60c to 1.40c in June, when about 650,000 tons of steel bar material were placed under contract, including a large tonnage of old contracts re-written. The consumption by harvester implement makers was good, by reason of the favorable crop conditions. Some of the re-rolled bar interests were quite aggressive in their competition, especially during the enforcement of the policy of price maintenance preceding the general reduction at mid-year.

Bar iron prices were subject to considerable fluctuation during the year, and the demand was not heavy owing to the attitude of the railroads. In the last quarter, when the dealers, by buying up and storing offered tonnage, dominated the old material market, bar iron was forced above the level of 1.40c which it had shared with steel bars after the June reductions.

Rails.

The extreme position of economy to which the financial stringency of the year forced the railroads affected the rail market most severely, and the past 12 months have been the leanest in this respect in the recent history of the iron and steel industry. Rail production in the country declined to approximately 1,325,000 gross tons, it is estimated, compared with 3,600,000 gross tons in 1907. Mill operations were very light. The limited tonnages placed by the steam lines for delivery during the year were slow in appearing, the Pennsylvania starting the movement through an announcement of 55,000 tons placed about the middle of February. Through a failure of the railroad and the mills to agree upon specifications, this order was never rolled. Some of the other important contracts placed were Great Northern, 45,000 tons; Atlantic Coast Line, 25,000 tons; New York Central, 24.000 tons; Harriman Mexican lines, 28,000 tons; Illinois Central, 25,000 tons; and the Baltimore & Ohio, 14,500 tons. Rail makers in November fixed the prevailing prices of $28 on Bessemer and $30 on open-hearth rails to apply to 1909 delivery. After prolonged negotiation, the Pennsylvania system closed for 135,000 tons, with a privilege of increasing this to 160,000 tons; the Chicago, Burlington & Quincy for 40,000 tons, and other lines in accordance, affording the mills distinctly better prospects for the new year.

Plates.

Light operations on the part of the steel car manufacturers and boat builders throughout the greater portion of the year made marked inroads upon the normal demand for plates, and it is estimated the production in the United States in 1908 was about 1,300,000 net tons, compared with 2 225,000 net tons in 1907. The Standard Oil Co. during the year continued actively at work upon its pipe line projects, and this directed a large tonnage to the mills of the United States Steel Corporation through the National Tube Co. The strength of steel pipe as a whole was a main source of support for the plate market in the year. Boiler steel trade was light, owing to limited new construction in the country and the decreased activity of railroad operations. Considerable shading of prices was done, principally by some of the smaller and independent mills. The general reductions in June provided the only official decrease from 1.60c to 1.40c on base sizes. Toward the end of the year there was more activity in steel car and boat construction and the demand for plates responded with some increase, which started the new year with a more favorable outlook. A large single contract of the year to be rolled at the Homestead works of the Carnegie Steel Co., was for 19,000 tons for a riveted pipe line for the Brooklyn water works system, which will be constructed by the T. A. Gillespie Co., Pittsburg.

Structural Material.

The shape mills in 1908 ran most of the time on part schedule, and the market as a whole was not active. The estimated output of the mills was 1,025,000 net tons, less than 50 per cent of the total of the preceding year. The railroads bought much below their accustomed tonnage. Several contracts of note awarded in the Pittsburg district were the Pittsburg & Lake Erie bridge at Beaver, Pa., 13,000 tons, and the Oliver building, 10.000 tons. Prices were steady, the one change in June reducing the base level from 1.70c to 1.60c. The restricted volume of business offered precipitated a severe cutting of prices by certain fabricators, causing much dissatisfaction among these interests. In November, at a meeting in Pittsburg, an organization of many of the representative companies was effected as the National Association of Structural Steel Fabricators, to promote the best interests of the trade. The steel for the New York City pier sheds, about 15,000 tons, which had been held up from the preceding year, was released early in 1908 and was rolled by Pittsburg mills.

Sheets.

Sheet consumption in 1908 was far below normal and reflected the light operations of manufacturing users and of limited mill and general construction. The jobbing trade kept its stocks at the low point and filed orders with the mills practically for immediate consumption only. Operations of the leading interest were at their maximum for the year, around 65 per cent, in September. Most of the year the mills were running between 50 and

60 per cent. The activity of the independents was maintained on a higher basis. Prices in sheets through a greater portion of the year were irregular and during many months, especially in the last half, shading was very general. Toward the close of the year an improvement was noted and the market was holding fairly firm at the close. In January an official reduction of $2 per ton on black sheets, $4 a ton on galvanized, and $1 on blue annealed was made. On some gages of black and galvanized sheets the cut was $4 and $6. There was no official deviation from this schedule in the remainder of the year.

Tin Plate.

The estimate is made that tin plate shipments in the United States during 1908 were about 90 per cent of those of the preceding year, when production reached about 600,000 tons. The fluctuation of operations in this product by reason of depressed business conditions is probably less than for any other iron and steel material, since canned goods, the source of greatest consumption in tin plate, are largely a staple article. At the beginning of the year there was considerable, though not abnormal, stock in the hands of consumers, and this had to be absorbed, while new buying was made more or less cautious by the prevailing uncertainties of general business, and these conditions slightly decreased the total demand. Crop returns were favorable and canning operations were approximately normal. The independent manufacturers enjoyed a very prosperous year, which was generally the best in their history, and their plants were kept close to full schedules a large portion of the time. The operations of the leading interest were not quite so favorable, although, comparatively speaking, the record of tin plate for the year was next to those of wire products, about the best of any of the products of the United States Steel Corporation. There was considerable price cutting in the year, and only one official change was made, which came in January, when a reduction on base boxes from $3.90 to $3.70 was announced. Terne plate demand was only fair. By a ruling of the Canadian government, tin plate became subject May 1 to the "anti-dumping" regulation.

Merchant Pipe and Boiler Tubes.

Considering the generally reduced activity of iron and steel products, merchant pipe makers experienced an especially good year and their consistent trade stood out in marked contrast with other lines, excepting only wire products and tin plate. The year will compare favorably with others which had been regarded as full and satisfactory periods. Oil and gas field goods moved well the major part of the year, particularly during the second and third quarters. Jobbers of merchant pipe were enabled to work off their held-over stocks without financial loss, and as the year ended, were showing a disposition to replenish depleted stores. Prices in steel pipe were very firm, but the iron pipe level was not so constant. The $4 a ton reduction on both iron and steel pipe in June gave the market a more settled tone. Among the principal large line orders placed were 400 miles of 12, 16 and 18-inch pipe by Standard Oil interests for a gas line from West Virginia to northeastern Ohio; 160 miles of 18 and 20-inch gas line by the Columbia Natural Gas Co. for a line from West Virginia to Cincinnati; 16 miles of 16-inch by the Iola Portland Cement Co. for Kansas; 30 miles by the Kansas Natural Gas Co. for a gas line in Kansas; and 100 miles of 12-inch, 40 miles of 8-inch, 15 miles of 10-inch, and 15 to 20 miles of 4 and 6-inch by the Oklahoma Natural Gas Co. for gas lines from the Oklahoma gas fields southwest to Oklahoma City, Guthrie, Shawnee and intermediate points.

Great activity has prevailed in gas and oil field work in the Kansas and Oklahoma fields during the past few years, and the business depression did not generally arrest these projects. The pipe mills profited accordingly. It is estimated that the Standard Oil and independent interests have expended fully $100,000,000 in new work in these fields during the past three years.

The boiler tube situation all year was unsatisfactory, but this is an expected result of the general condition of commercial affairs, since new power construction was limited and the railroads were light buyers of any tonnage beyond maintenance. Prices have been subject to considerable shading by some interests, but there were no changes in official quotations all year.

Old Material.

The old material market offered some interesting features during 1908. In the dullest period of the industry, the dealers began to absorb the limited offered tonnage of scrap and stored it in their yards for a rise in the market. As business showed signs of revival they continued to outbid the consumers, and as a consequence heavy steel advanced to $16.50, delivered this district, and rolling mill scrap to $17.50 delivered in December, representing respective rises of $3 and $3.50 a ton over the year, all of which came in the last half. This condition forced the mills with uncovered requirements to adopt a cautious buying policy. At the close of the year, it was conservatively estimated that 50,000 tons of all grades were held in dealers' yards in the Pittsburg district with 20,000 tons at Youngstown.

Labor Conditions.

While the year offered the opportunity for serious discord between employer and employed, because of the demands of some manufacturers for lower wage costs and because of the general reduction in iron and steel prices, no labor troubles of consequence resulted. A general readjustment of wages was avoided, as was desired by iron and steel makers in connection with the lowering of prices to meet the changed trade conditions. Deliberation characterized the conference between the manufacturers and the Amalgamated Association of Iron, Steel and Tin Workers upon the adoption of the annual wage scale, but in the end the workmen accepted moderate reductions and an amicable settlement was made. At its annual convention at Youngstown, O., the Amalgamated association adopted as its convention scale for presentation to the employers, the scale that had been in force the preceding year. The first conferences with the Republic Iron & Steel Co. and the Western Bar Iron Association upon the bar scale left the workmen and manufacturers far apart in their views. Subsequently at a second conference in Detroit an agreement was reached between the Western Bar Iron Association and the Amalgamated association, the latter accepting a reduction averaging 7 to 8 per cent. Earlier in the year, the Republic had abrogated its continuous working agreement with the Amalgamated, which provided the manner of arbitration in the event of a disagreement at the annual conference, and insured the operation of the mills while the merits of the case were being considered. The Western Bar Iron Association had taken practically a similar stand, but had adopted a substitute agreement which entails the selection of but one disinterested conciliator where arbitration is made necessary, instead of five under the old plan.

After the adjustment of the wage question between the men and the Western association, a similar result was quickly reached at a second conference of the union with the Republic, the same

scale reductions being accepted. The American Sheet & Tin Plate Co. had little trouble in arranging the sheet and tin scales with the men, the reductions adopted being 2 per cent in sheets and 6 per cent in tin plate. Independent manufacturers generally signed the bar, sheet and tin plate scales agreed to at the several conferences. These scales are in effect until July 1, 1909.

The bi-monthly settlements in 1908 between the Amalgamated association and the manufacturers, based upon the actual selling prices of bar iron, sheets and tin plate to fix the wage rate paid the workmen in these mills, were as follows:

IRON WAGE SETTLEMENTS.

	Basing price bar iron.	Boiling rate per ton.
January-February	1.55c	$6.37½
March-April	1.45c	6.12½
May-June	1.45c	6.12½
*July-August	1.35c	5.37½
September-October	1.30c	5.25
November-December	1.30c	5.25

SHEET AND TIN PLATE SETTLEMENTS.

	Sheets. Base $2.30 to July $2 50 thereafter.	Tin Plate. Base $3.40 to July $3.90 thereafter.
January-February	Base	Base
March-April	Base	2% over base
May-June	Base	Base
*July-August	Base	Base
September-October	Base	Base
November-December	Base	Base

*New scale in effect.

NEW CONSTRUCTION.

Blast Furnaces (Merchant).

Rebecca furnace, Kitanning, Pa., rebuilt by Kitanning Iron & Steel Co.; still idle.

Scottdale furnace, Scottdale, Pa., rebuilt by Corrigan, McKinney & Co.; about to blow in.

Shenango furnace No. 1, Sharpsville, Pa., new stack erected by Sharpsville Furnace Co.; blown in in July; No. 3 stack being rebuilt and enlarged.

Grace furnace, Youngstown, O., rebuilt by Brier Hill Iron & Coal Co.; blown in during September.

Blast Furnaces (Non-Merchant).

A. & B. furnaces, Youngstown, O., new stacks erected by Youngstown Sheet & Tube Co.; blown in during November.

Tod stack, Youngstown, O., being rebuilt by Youngstown Steel Co.

Ohio furnaces Nos. 5 and 6, Youngstown, O.; being erected by Carnegie Steel Co. at Ohio works.

Duquesne furnaces Nos. 5 and 6, Duquesne, Pa.; being erected by Carnegie Steel Co. at Duquesne works.

Eliza No. 4 furnace, Pittsburg; rebuilt by Jones & Laughlin Steel Co. and blown in during August; three furnaces building at projected Aliquippa works.

Steel Works.

Pittsburg Steel Co., eight 60-ton basic open-hearth furnaces completed at Monessen, Pa., works, and put in operation in August.

Carnegie Steel Co., six 60-ton basic open-hearth furnaces completed at Duquesne works, and 12 additional furnaces under construction; 12 60-ton basic open-hearth furnaces under construction at Ohio works, Youngstown.

National Tube Co., six 50-ton basic open-hearth furnaces under construction at Lorain, O.; plant will be completed in February.

Page Woven Wire Fence Co., one 50-ton basic open-hearth furnace built at Monessen, Pa., and put in operation during July.

Jones & Laughlin Steel Co., four 250-ton Talbot basic open-hearth furnaces building at South Side works, Pittsburg; will be completed in June; six Talbot basic open-hearth furnaces projected for new Aliquippa works.

Finishing Mills.

Carnegie Steel Co., remodeling 21-inch mill at Duquesne works.

Youngstown Sheet & Tube Co., three pipe furnaces completed and three under way at Youngstown works; new galvanizing plant erected and capacity of rod and wire mills doubled at Struthers, O., works.

La Belle Iron Works, 72-inch plate mill and eight sheet mills at Steubenville, O., plant, completed and put in operation.

A. M. Byers & Co., 44 single puddling furnaces and 16-inch skelp mill under construction at Girard, O.

Clark Steel Hoop Co., new hoop mill under construction at Punxsutawney, Pa.

American Sheet & Tin Plate Co., four 26-inch hot sheet mills at Guernsey plant, Cambridge, O., one 26-inch jobbing and one 26-inch hot sheet mill at New Philadelphia, O., plant, and galvanizing plant of six pots at Scottdale, Pa., works, completed and put in operation.

National Tube Co., 40-inch blooming mill replaced and 18 pipe welding furnaces under construction at McKeesport works; will be completed by fall.

Pittsburg Steel Co., 46-inch blooming mill, 28-inch finishing mill, continuous mill and wire mills completed and put in operation at Monessen, Pa., works.

Miscellaneous.

Universal Portland Cement Co. completes and puts in operation plant at Universal, Pa., with 4,500 tons daily capacity, manufacturing from slag of Carrie furnaces; doubling of works planned.

MUCH BRIGHTER OUTLOOK FOR THE NEW YEAR

As Compared With the Twelve Months Just Passed — Ups and Downs of the Pig Iron Market as Viewed From a Cincinnati Standpoint

By Joseph D. Morten.

The year 1909 begins under decidedly more encouraging conditions than did the year 1908. At the close of 1907, the country was in the throes of an industrial and financial panic; the outlook was uncertain and pig iron producers began that period with furnaces blowing out for lack of business and production being steadily curtailed and prices declining.

The year 1908 began with southern No. 2 foundry quoted at $13 Birmingham and prices steadily declined until sales were made in the latter part of May at $11. Conditions were unsatisfactory in these first five months for the southern producer, as consumers were holding up shipments due on high priced contracts and the melt had fallen off until estimates were made that the consumption was about 25 per cent of normal capacity.

Early in the year, one of the large southern producers sold freely for first quarter and first half delivery at $12 to $12.50 Birmingham, which price was met in March by other producers, so that by April consumers of southern iron were practically covered for the first half of the year and offerings at $12 Birmingham were neglected. On the first of April a canvass of southern stacks developed that 20 were in blast and 35 were idle. This statement indicated that there had been no important change in production in the south between Dec. 1, 1907, and April 1, 1908.

Efforts to Establish Price.

In May efforts were made to es-

tablish a price for southern iron by an agreement of southern producers. The meeting was held in New York and reports were circulated after the meeting that a price of $10 Birmingham had been under discussion. The daily press exploited this proposition so widely that the whole situation became unsettled. At this time there was also under discussion a proposition to market southern pig iron through one selling agency, which proposition, however, failed to receive sufficient support to result in its accomplishment.

In the latter part of May, consumers apparently became convinced that $11 to $11.50 Birmingham was low enough and a buying movement developed. The consumers took considerable iron for second half delivery, resulting in an advance of prices, so that the month of June began with the market strong at $12 Birmingham, two large producers sold up for the third quarter and 11 southern furnace companies not quoting, out of the market and out of blast. Before the close of June, buying had ceased and the market became dull. At this point there was a decline in the price of Lake Superior ores, which had the effect of causing consumers of pig iron to withdraw from the market. The melt had continued light through the first half of the year and melters were not taking their full quota of iron on contracts.

During the first week in July, the price of southern iron again weakened and sales were made at $11.50 Birmingham. In the latter part of this month, some heavy purchases were made by Detroit stove makers, deliveries extending into 1909.

August Buying.

Another buying movement developed in August and a liberal tonnage was placed at $11.50 Birmingham; the purchases being mainly made by large consumers, and prices again advanced to $12 Birmingham. In the middle of August, it was estimated that the unsold stock on hand at southern furnaces was about 70,000 tons, and there were 22 stacks in blast, indicating a gain of two stacks since March. The coal miners' strike in the Birmingham district occurred in this month and southern producers were forced to buy coke in Wise county and Pocahontas districts. During this period production was somewhat hampered.

Northern producers had gradually reduced their prices until they were selling at $15 at furnace, during August, which made the price of southern iron in a large part of the territory north of the Ohio River higher than northern, but southern producers maintained a firm attitude, with a number of producers asking $13.

The market remained stationary and quiet during September. The Birmingham coal strike was settled. Buyers' wants were practically covered for the remainder of the year and southern furnaces had enough orders on their books to enable them to maintain prices. The inquiry was for the first quarter of 1909 and furnace prices were $13 to $13.50 for delivery in that period.

The market remained quiet during October—by this time there were 24 stacks in the southern zone in blast. During the latter part of the month, there was some shopping in anticipation of better conditions following the election and some orders were taken contingent upon Mr. Taft being successful.

November Activity.

A buying movement developed early in November and a large tonnage was sold for first quarter and first half of 1909, at $12.50 Birmingham. On this buying movement, prices advanced to $13 and northern stacks advanced their prices to $15.50 at furnace, resulting in a better adjustment of delivered prices in northern territory. A noticeable feature of the buying was that melters covered for only a portion of their normal melt, so that the large volume of business booked was due to the general buying of all classes of consumers.

The year closes with consumers fairly well covered, based on the present rate of consumption, for the first quarter of 1909, and partially covered for the second quarter; buying is not general, but large consumers are coming into the market each week with inquiries for liberal amounts, showing a much improved condition of business.

Some features of the southern pig iron situation were unusual during the past year;—the scarcity of low grade iron was noticeable, as furnaces produced more heavily of the high grades than usual and cast-iron pipe makers were heavy consumers throughout the year and bought all of the low grade iron available rapidly enough to prevent accumulations of gray forge, white and mottled irons. At times relatively strong prices were paid for these grades.

In the review of the market for 1907 it was estimated that southern consumers had during that year taken about 60 per cent of the southern production. In 1905 it was estimated that they took about 52 per cent of the southern production. During 1908 the same authority estimates that the south has consumed about 61 per cent of the southern furnace output, which is about the same as for the preceding year. The conditions, however, during 1908 were somewhat peculiar as part of the time the northern producers were underselling the southern makers in considerable of the northern territory, and it may be mentioned also that the production in the south was considerably decreased as compared with 1907. The most competent observers, however, agree that the tendency is in the direction of a steady increase in southern consumption of pig iron, and the fact that the southern producers appeared to ignore the action of the northern stacks in under-selling them was attributed to the demand upon southern furnaces for pig iron for consumption at home.

Prices of Southern Iron (Spot).

Date, 1907—	Southern No. 2, Birmingham.	Gray Forge, Cincinnati.
January average	$12.80	$14.45
February average	12.50	14.06
March average	12.12	13.63
April average	11.90	13.60
May average	11.50	13.50
June average	12.00	13.75
July average	11.60	13.70
August average	12.06	14.00
September average	12.50	14.25
October average	12.50	14.25
November average	12.50	14.25
December average	13.00	14.75

The Walcott & Wood Machine Tool Co., Jackson, Mich., advises that its new factory building is about completed. It is 70 x 135 feet, with monitor the whole length. In construction a 13-inch brick wall was used, with windows as close together as they could be gotten in the monitor and sides. The roof and monitor are both of heavy mill construction. New offices will occupy one end of the new building. The company has placed an order for a Niles electric traveling crane which will run in the monitor. The machinery will occupy the side bays, and the center bay, 25-foot span, will be used for erecting purposes. The company intends to remove its equipment from the old to the new factory house, using the old structure for stock room, bench room, etc. It will add new equipment gradually, but not any in the near future. It expects to move into the new shops in June, and then will have shop capacity for employing about 150 men.

The production of platinum in the United States in 1907 was 357 Troy ounces, valued at $10,589, as compared with the production in 1907 of 1,439 ounces, valued at $45,189.

STEADY AND SOUND IMPROVEMENT EXPECTED

REVIEW OF THE PAST YEAR FROM AN EASTERN STANDPOINT

Story of the Effort to Promote Conciliation and Co-operation—Violent Fluctuations Prevented—Struggle Over Steel Rail Specifications—Buying of Foreign Ores—Effects of Tariff Discussion.

(From Issue of Jan. 2, 1908)

Although developments at the close of the old year were not as positive as might have been hoped for, there were enough favorable indications to justify a cheerful feeling. An exaggerated importance has been attributed in some quarters to resumptions of operations of plants which were closed before Christmas. It was certain that the almost complete inactivity of the holiday season would not continue indefinitely, and some plants have resumed, while others are preparing to do so, but it is too early to predict to what extent increased production will be justified by demand.

(From Issue of July 2, 1908)

The first half of the year, which has been one of the most trying periods in the history of the iron trade, closes with some encouraging signs. Progress toward recovery, slowly but surely, has been made, and there is reason for hoping for a continuance of this progress. The prospect of avoiding serious labor conflicts is more favorable. The signing of the wage scale affecting sheet and tin plate workers and the failure of the unions to precipitate a strike on the lakes are among the indications that there is little danger of disastrous conflicts between labor and capital.

(From the Current Issue)

The new year opens with its full measure of promise, an important element of strength being the moderateness of the return from the trying conditions of the depression toward a normal business activity. It is probable that no sharp acceleration of this pace can be looked for, but a fair and healthy improvement, on a substantial basis of actual requirements, seems reasonably certain. The possibilities of over-production, through the too hasty resumption of idle capacity, must be considered, as must also the uncertainties of the tariff; but these elements are recognized and, wherever possible, have been discounted.

By B. S. Stephenson.

In the light of events of the 1908 iron and steel trade in the United States, some grim, though highly respected, economic theories have largely lost their terror. The industry has learned the power of honest co-operation. It has found that, even in the face of a sharp and persistent business depression, a judicious curtailment of production can avert the season of violent and disastrous price-cutting which had long been considered inevitable. In the case of steel rails, this discovery was made some years ago, but not until the trying times of the year just ended was its extension to include all the more important steel lines deemed possible.

As previously, in times of abnormal activity, the trade had shown its ability to prevent the soaring of prices to unstable levels, there is reason to believe that hereafter producers of iron and steel products, as well as consumers, can rely upon the fluctuation of prices within much more narrow limits, than in the past, thus largely removing one of panic's most destructive features. Prof. Taussig of Harvard recently told the House Ways and Means Committee that these violent price fluctuations have proven "One of the greatest curses of modern industrial life," and spoke in most praiseworthy terms of the United States Steel Corporation's policy of "tempering them."

The so-called "'Gary movement" is popularly connected with the four "Gary dinners"—three during the winter and spring and the last early in December. At its inauguration, economists and trade experts generally were skeptical of the movement's outcome, and free to express this skepticism. There was little in the way of precedent to guide its leaders, the depression had come on unexpectedly and from unusual causes which did not disappear, governmental activities were not such as to hasten the return of normal conditions, and finally, in carrying out its policy of co-operation the industry had to be constantly on guard against any method of operation which might lead to a suspicion of illegal combination. The outlook was not particularly attractive.

How the work was carried on is a matter of common knowledge. Full publicity was given the movement. After each meeting an extensive statement was issued by Judge Gary, and these were supplemented by less formal expressions from time to time. Following the initial meetings of the leading manufacturers, the campaign was largely turned over to a general committee and to several special subcommittees, each dealing with one important line of product. The success of the movement was probably even more complete than those responsible for it had expected. One general reduction in prices was made in June, this being accompanied by a cut of 50 cents per ton in the price of Lake ores. These prices were not absolutely maintained: there was more or less constant shading in plates by smaller interests and fabricated steel bids dropped to such a level as to indicate pretty positively that certain fabricators were obtaining concessions in structural materials. But these features never developed particular prominence, and the all-important object of the movement—to prevent a general steel war—was clearly accomplished.

Growing out of the meetings incident to the Gary movement, a permanent organization known as the American Iron and Steel Institute was formed early in the year. Its membership list is already large. Its directory board of 15 representative manufacturers is proceeding deliberately in completing plans for important work along a number of lines with which the industry is vitally concerned.

The new year opens with its full measure of promise. An important element of strength lies in the extremely moderate rate of the return from the trying conditions of the depression toward a normal business activity. It is probable that no important acceleration of this pace can be looked for, but a fair and healthy improvement, based on a substantial foundation of actual requirements, seems reasonably certain. The possibilities of over-production, through

the too hasty resumption of idle capacity, must be considered, as must also the uncertainties of the tariff: but these elements are recognized, and, wherever possible, have been discounted.

Slow Recovery in Iron.

The pig iron market has been in a convalescent state throughout the year. Its course has been constantly in the right direction, but the rate of improvement, slower than even the modest predictions, has at times been almost imperceptible. With the blast furnace operations of the Steel Corporation ranging from under 20 per cent at the beginning of the year to about 60 per cent at its close, with independent steel makers operating on about the same percentage of normal, and with the consumers of merchant iron melting an average of not over one-half capacity throughout the year, the widespread blowing out of furnaces in the closing months of 1907 proved none too extensive, and the curtailment of production held constant through the first half.

Eastern furnaces, being chiefly makers of merchant iron, bore their full brunt of the trying conditions. January opened with only four stacks operating in the entire Schuylkill Valley. For a considerable part of the year, the Wharton interests, with four furnaces in New Jersey, and the Thomas Iron Co., with nine Pennsylvania furnaces, operated but one stack each. Even with a curtailment as general as indicated by these instances, it was May before the Eastern Pig Iron Association furnaces showed any important reduction in stocks. However, from that time on through the year, accumulations in furnace yards steadily decreased, particularly during the fall months, while order books filled up at a rapid pace.

The year opened with 2X foundry iron held at the rather nominal quotation of $17.50, with basic at $16.50; eastern furnace, but buying was of insignificant proportions and before the turn of the year these figures had sagged to $16.00 and $15.25, respectively, and slightly lower levels prevailed at times during the third quarter. Brisk buying in August, however, for last quarter shipment, and again in November, for the first quarter of 1909 principally, cleared up accumulations to such an extent that the year ended with prices averaging from $1.00 to $2.00 above the low levels and with producers generally not anxious to sell. Production costs throughout the year held close to selling prices.

An important feature of the year was the decision to operate the several Lackawanna stacks at Lebanon as merchant stacks, making use of local and Port Henry ores. The idle period was quite generally taken advantage of to overhaul and modernize the older furnaces in the district, and the return of normal activities will find eastern producers probably better equipped for iron-making than ever before. Early in July Worth Bros. at Coatesville broke ground for the erection of a 450-ton blast furnace, arranged for hot metal connection with their steel plant, and other stacks will be built on the completion of the first. It is known that at least one other independent still interest in that section expects to equip itself for the manufacture of its own pig iron in the early future. About the middle of the year, the newly-incorporated Oriskany Ore & Iron Corporation leased for three years the properties of the Allegheny Ore & Iron Co., a constituent of the Lukens Iron & Steel Co. owning three Virginia furnaces.

Foreign and Eastern Iron Ore.

During the year steady progress has been made by the Pennsylvania Steel Co. interests in developing the vast deposits of Mayari iron ore on the north shore of Cuba, where it is estimated that 600,000,000 tons are in sight. For this work, which was begun in May, 1907, a $1,000,000 bond issue was sold in July of the past year, and some ore will be shipped during the coming season, both by the Spanish-American Iron Co. and, to a limited extent, by an independent miner. The ore is a surface deposit and its mining a steam shovel proposition.

Owing to the high cost of Lake Superior ores delivered east of the mountains, consumers near the coast seem more and more inclined to depend upon local and foreign supplies. The closing month of 1908 was featured by very extensive contracting for Spanish and Newfoundland ores. In two weeks, sales aggregated over 600,000 tons of the foreign product, it being generally stipulated that the purchaser should have full benefit of any reduction in the present tariff schedule. The increased activities of the Bethlehem Steel Co., through the operation of its new works, will mean a much heavier call upon its Cuban ore deposits.

The Ferro-Alloys Market.

The reduced activity of the steel industry throughout the year naturally held down imports of ferro-manganese and other alloys to a low figure. Prices were generally but little above production cost, the range being from $48.00, seaboard, early in the year down to $41.00 or $42.00 on some good tonnages during the summer and up again to $45.00 at the close of the year. In November and December, there was extensive covering by steel mills of their 1909 requirements, either in whole or part, and the new year opens with the market strong. An interesting announcement, made in connection with the tariff hearings at Washington, was to the effect that if the present duty of $4.00 per ton on ferro-manganese is allowed to remain, New York interests owning large deposits of manganese ore in Virginia stand ready to spend $500,000 in the erection of a furnace plant for the manufacture of this alloy. Ferro-silicon and spiegeleisen have been in small demand and low throughout the year.

The Year in the Steel Trade.

Except for the one general reduction announced early in June, the standard prices on practically all lines of finished and semi-finished steel products held without change throughout the year. This reduction was coincident with a cut of 50 cents per ton on Lake Superior ores, and did not result in any important increase in orders, but it did afford a measure of relief to numerous contractors who had taken low-priced work and discounted the probability of such a cut. At no time were billets in brisk demand, and only a few tonnages of importance came to light during the year; prices were generally well maintained. One noteworthy transaction was the sale by corporation interests late in the year of a large lot of sheet bars for export to Great Britain. Export trade, in fact, was fairly active throughout the year, holding its own considerably better than import trade.

Brisk competition for the limited volume of structural steel work current sent fabricated prices very low early in the year and substantially no recovery was made. A careful estimate places the year's contracts at 1,050,000 tons for the entire country: of this roughly 250,000 tons went to the American Bridge Co. and 800,000 tons to independent interests, the latter taking a much larger relative tonnage than usual. The American Bridge Co. entered the year with close to 400,000 tons of contracts on its books, and carries about 200,000 tons into 1909, having made ship-

ments on some 350,000 tons, or about 50 per cent of its normal capacity.

The fact that New York is constantly engaged at the task of rebuilding its down-town section, coupled with a growing activity in the construction of apartments and loft buildings and in the improvement of its water front, renders it an important building center even in the most trying times. The North River pier sheds, the last of which is now being figured on, consumed an immense steel tonnage during the year. Some of the largest structural contracts closed were for hotel and office buildings, though transportation and terminal improvements called for heavy tonnages. From these sources, as well as from some ambitious municipal projects, a good volume of business is in prospect for 1909. Contracts are still going at such a level of prices that it is difficult to understand how the fabricator can get a new dollar for an old one, unless, as is quite generally intimated, concessions on plain materials are being made by a few scattered mills. Two waterworks extension projects in the east, closed late in the year, called for close to 25,000 tons of plates for the manufacture of lock-bar pipe. Shipyard work was extremely light.

In this connection should be mentioned the important part played by the new Bethlehem sections, rolled on the Gray mill at South Bethlehem, in replacing built-up sections in structural work. A heavy tonnage of this product went into eastern buildings during the year. Another feature of interest was the completion in the early part of 1908 of the Waverley warehouses of the Carnegie Steel Co., giving several daily deliveries to New York tidewater and to the export piers.

End of the Rail Controversy.

Early in the year, when the Pennsylvania system offered the rail-makers orders for 55,000 tons on its own radically-drawn specifications and the mills declined the business, a controversy arose which persisted until December. By carefully hoarding the considerable tonnage carried over from 1907, the Pennsylvania was able to avoid purchasing through the year. Other lines followed its example, wherever possible, and in sticking to this purpose were mightily aided by the fact that curtailed earnings and impaired credit rendered impossible the filling of any but the most imperative requirements. The percentage of operations of rail mills through the year was extremely small, and their ability to run even at a low figure was due largely to their considerable sales abroad, which, according to Mr. Schwab, were proportionately much heavier than usual.

The placing of the Pennsylvania's probable requirements for 1909, reported about the middle of December, marked the ending of the contest and was coincident with a marked improvement in general railway earnings. These contracts provide for later specification as to the proportion of open-hearth and Bessemer rails; the amount of discard from the ingot is left to the discretion of the manufacturer, subject to the usual inspection, and different prices for various grades of rail are provided Aside from the Burlington, which placed 40,000 tons at the same time, the Pennsylvania order had no immediate stimulating effect. Frogs and switches and other railroad specialties were in good demand through most of the year. One of the strongest indications of returning prosperity was the placing during the fall months of orders for a very considerable number of cars, chiefly of all-steel construction. Locomotive orders, however, were not numerous. Bridge work was held to the minimum throughout the year and did not aggregate its usual tonnage.

An event worthy of note in this connection was the acquisition, early in July, by the United States Steel Corporation of the Schoen Steel Wheel Co., operating a large plant at McKees Rocks, Pa.

Bar Iron and Pipe.

Bar iron prices have exhibited a wide range during the year, depending chiefly upon the maker's eagerness for orders. An open market has prevailed in the east for some months. Mills ran rather intermittently and the year was generally unsatisfactory, though in December prices firmed up considerably in line with the higher level of scrap.

In cast iron pipe, eastern foundries were engaged in such brisk competition for orders that the limited tonnage placed was at prices little, if any, above actual cost. Late in the year after the pig iron advance had set in, pipe makers found considerable difficulty in covering their requirements at a figure which would allow them to come clear on their low-priced bookings. The new plant of the Standard Cast Iron Pipe & Foundry Co. at Bristol, Pa., with a capacity of 350 tons per day, was in partial operation before the end of the year. It is designed in a way that is expected to produce remarkable economies.

After an extremely quiet period lasting until well into the fall, the scrap market of the year was featured by a brisk upward movement with a joint attempt by eastern steel mills to hold down the price of heavy melting steel. This effort met with a severe set back when one large consumer closed for 25,000 tons at a considerable premium over the agreed price. Scrap in the east at the close of the year was not plentiful, the accumulations held for higher prices being very small in comparison to those in the Chicago district.

The year witnessed an important advance in steel-making practice through the adaptation of the Gayley dry air blast to the Bessemer converter, the experimental application at the South Works of the Illinois Steel Co. being eminently successful. The resulting improvement in the quality of steel produced is counted upon to aid the Bessemer process materially in holding its own against the inroads of the open-hearth. A German steel plant is now installing the system. During the year, close to a dozen furnaces were licensed for equipment with the dry blast. The retirement of Mr. Gayley from the first vice presidency of the Corporation was announced late in the year.

Although there has been much discussion of a reorganization plan, receivers are still operating the big Staten Island plant of Milliken Bros., Inc. The Passaic Steel Co. having closed down its steel mill, another interest has undertaken the manufacture there of manganese rails. The Lebanon Iron & Steel Co., Lebanon, Pa., has been purchased by its bondholders and is to reorganize.

The Tariff and the Trade.

A disturbing factor entering the iron and steel trade after the election uncertainties were settled was the prominence given to the proposed revision of the tariff. The widespread interest in the hearings before the Ways and Means Committee of the House of Representatives, before which Judge Gary, Andrew Carnegie, Charles M. Schwab, E. C. Felton, Willis King and numerous other prominent figures in the iron and steel trade gave their views on the needs of the industry, had the effect of reducing specifications on steel products quite appreciably during the closing weeks of the year.

GLOOMY YEAR IN THE BRITISH ISLES

Severe Depression Extended to Nearly All Lines, the Exceptions Being Corrugated Sheets and Tin Plate—Heavy Decrease in Shipbuilding—Outlook Encouraging

By J. Horton.

The year 1908 has more than justified the gloomy anticipations entertained at its commencement. It has, in fact, brought a succession of disappointments. Repeatedly, slight revivals have encouraged hopes foredoomed to disappointment. The year, it will be remembered, commenced with a bank rate at the exceptionally high figure of 7 per cent. Reductions followed in quick succession until for some months past the rate has been only 2½ per cent. The general supposition was that the high bank rate was mainly responsible for business stagnation, and for this, it was the fashion to lay the blame upon America. Yet the fall in the bank rate has practically had no effect at all upon business. In the early spring there was a constant expectation of big contracts to be given out by railways, municipalities and others, which, it was supposed, were waiting for reasonably cheap money. Really, the remarkable feature of the year is the almost complete absence of heavy contracts, such as bridges, buildings, piers, and other large metallic structures. One of the largest structural firms in the kingdom declares that the year has been the worst it has known for 20 years past, in respect of the small number of contracts on the market, and the perfectly ruthless competition for such trifles as were available.

Buying Must Come.

It is inevitable that there must be a reaction. There must, before long, be extensive replacements of decaying and corroding structures, and as prices are now fairly steady, there is a hope that municipalities will soon consider the right moment has arrived for further enterprise. Several months ago a strenuous effort was made to form a combine of the various structural engineers, with a view to arresting competition. From the first it was recognized that the exclusion of some of the largest firms was a fatal weakness, and this vitally important circumstance has now involved the scheme in failure.

The exceptional dullness of demand in ship building lines and on behalf of the railroads is largely responsible for the depression. Amalgamations of most important railways have facilitated considerable economies, and this movement is likely to continue. One of the objects is the prevention of overlapping, both in the running of unnecessary trains and the maintenance of unprofitable district agents and offices. A considerable number of railway workers have been thrown out of work, and there is a marked reduction in rolling stock orders. Within the last six weeks, a number of new rail orders have been placed and as the bottom seems now to have been touched, it seems likely that the authorities will soon discern the correct moment for renewing both their roads and their rolling stock. Birmingham is one of the great wagon building centers of the world, and for years the leading firm maintained activity, even when the iron and steel trades generally were slack. But 1908 was an exception. The great concern of the Metropolitan Amalgamated Co., which is believed to have the largest productive capacity in Europe, has had to shut down two of its works, and dismiss a large number of men. At present it is notorious that work is being done practically at cost price, with the object of keeping the men employed. The last month of the year saw a slight improvement in this industry, largely owing to better orders from the east, and especially China and Japan. South America is also buying cars rather more freely. The British makers have found themselves confronted with determined competition from Austrian and Belgian car builders, and there was quite a scramble recently for some luxurious car orders on offer for the Khedive of Egypt, but eventually the orders have come to Birmingham. A few years ago this country had a monopoly of the Egyptian work, but that state of things has passed away. It is believed that the railways must buy heavily pretty early in the new year.

Slump in Ship Building.

The slump in ship building, which for months resulted in almost complete stagnation, severely hit the South Staffordshire chain trade and has forced down prices, so that at the present time the workmen are disputing an enforced reduction in their wages. Sheffield, Middlesbrough, and the Hartlepools have suffered mainly through the poor demand for ship plates. But Sheffield has been doubly hit by government economies in ship building, which have kept to a minimum the demand for armor plates. Latterly, the government has given out some important orders for battleships, but they have not yet sufficiently materialized to set the mills extensively in operation. The ship building strike, and the cotton strike, both of which lasted for months, needlessly intensified a situation already sufficiently gloomy. In Sheffield a good deal of attention is being given at present to experiments having for their object the casting instead of the rolling of armor plates, and some experts are hopeful of success, involving revolutionary results to this branch of the trade. There are no signs as yet of any material improvement in the ship building industry, although the great fall in steel prices would seem to render the present period favorable for economical ship construction. The co-partnership scheme of Sir Christopher Furness in the north of England, taken up with some heartiness by a large number of ship yard workers, is an experiment attracting considerable attention.

Returns to Wages Board.

The persistent descent of the finished iron trade is well exemplified by the bi-monthly returns of the past 12 months in connection with the Midland Iron and Steel Wages Board. For September and October, 1907, the average selling price in the South Staffordshire district was £7 10s 6d. Then there was a steady fall for each of the two months as follows: November and December, average, £7 9s 9d; January and February, £7 4s 11d; March and April, £7 3d; May and June, £6 16s; July and August, £6 9s 8d; September and October, £6 6s 11d. These reductions have brought down wages from 9s 6d per ton for puddling to 8s 6d, or in all 10 per cent reduction for puddlers and forge and mill men. Prices have been so finely cut lately, that the next return is almost certain to show a still further reduction. It is remarkable that the output of the 17 selected firms

has kept up fairly well, being 37,359 tons for September and October, 1908, as compared with 39,826 tons for the corresponding period of last year. Throughout the year the South Staffordshire works have kept in very fair employment on hand to mouth orders, although there is every reason to believe some of the establishments have been carried on at an actual loss, as the combined results of high wages and dear raw materials. Several establishments have been closed through their inability to stand the strain.

In the north of England the fall in prices has hardly been so violent, but the returns have included some depressing features. The return under the Northern Wages Board for September and October gave an average selling price for rails, bars, plates and angles of £2 12s 3d, as compared with £6 14s 3d for the previous two months, and £7 6s 9d for the corresponding period of 1907, representing a decline of 14s 6d. In the north of England the fall in output, rather than prices, has been the noticeable feature. During 10 months this year the output was 34,292 tons, against 55,458 tons in 1907, a reduction of 24,176 tons, the greatest fall ever recorded in the history of the trade. Wages in the north are 8s 6d per ton for puddling, against 9s 3d a year ago, representing a fall of 7½ per cent in wages, as against 10 per cent in the Midlands. It is quite usual for fluctuations upward and downward in the Midlands to be more violent than in the north of England.

Sheets and Tin Plate.

An exception to the rule is galvanized corrugated sheets, which have been maintained throughout the year at £12 10s, a figure reached in January, last, after a reduction of 12s 6d was declared. The maximum price during the boom was £13 17s 6d. But it is considered no small achievement to have maintained £12 10s, while every other article on the market has come down so persistently. The selling figure is being maintained in spite of a decrease in shipments, during the 11 months ended November, of 86,172 tons, the total export being 354,713 tons. This price maintenance is the best thing yet effected by the galvanized sheet combine, which includes practically all the principal makers. A statement was published a few days ago that the combine had been extended to America, but the declaration was publicly denied by S. R. Lysaght, of the firm of John Lysaght, Ltd., of Newport, a denial which must be accepted. Another line which has done well is that of tin plates, the exports of which for the 11 months reached a value of £5,036,649, as compared with £5,450,694, a comparatively trifling reduction. It is only in respect of home consumption that this trade has suffered. The foreign trade has been excellent, especially with China, Japan, South America, and Russia, with very fair shipments to America. The makers have their order books furnished well into the New Year, and some are putting down new plant. The wire trade has, on the whole, done badly, and towards the end of the year suffered rather severely from German competition. This branch is worse off than during periods of depression in the past, owing to the great falling off, as compared with such periods, of semi-raw steel imports, which on former occasions have given British makers an almost irresistible advantage in open markets.

Bars and Billets.

Marked bars have maintained their reputation for steadiness. The makers in January, last, firmly resisted a clamor for reduction, but in midsummer brought down prices from £9 to £8, at which figure they still remain. One of the signs of recent revival is the placing of an order by a railway company for 1,500 tons of marked bars. It is unlikely that this commodity will now be further reduced.

The comparatively small imports of foreign steel billets have been the subject of universal comment. This is understood to be due partly to a definite change of policy on the part of German, Belgian and American producers. It is also due to the great fall in British prices. Bessemer sheet bars are now £4 12s 6d, whereas in May of 1907 they were £6 7s 6d. No serious financial results seem to have followed from these heavy reductions, but this is partly due to the policy adopted by many companies of setting aside substantial reserves during the boom periods, in anticipation of the depressing times which were known to be in store. The policy has really succeeded very well, billet imports apparently being restricted to a single contract reaching this country by way of Newport, and for which the United States Steel Corporation is understood to be responsible. In spite of the depression, some firms have done extremely well, the Staveley Coal & Iron Co., for instance, paying a 20 per cent dividend; the Sheepbridge Coal & Iron Co., 12½ per cent; the Steel Co. of Scotland, 7½ per cent; Pearson & Knowles, 11¼ per cent; and the Ebbw Vale Steel, Iron & Coal Co., 10 per cent. There are, however, some important exceptions, and generally the earnings show a material falling off, but it should be stated that several of the largest concerns are building or have already completed new plants, in expectation of heavy business which cannot now be very long postponed.

Finished Steel.

The trade in finished steel has suffered severely from the ship building slump. This is hardly to be wondered at, seeing that the output on the Clyde during the year has been much the lowest for 10 years past. During the 10 months ended October, the Clyde output was 272,648 tons, as against 500,823 tons in 1907. The trade in finished steel has been only moderate during the year, largely on account of the poor demand for structural purposes. Various efforts have been made to secure an international combine, but they have been unsuccessful, except in regard to steel rails, in which a fair amount of success has been realized, although towards the end of the year there were reports of friction over the amount of work allotted to America. There is every probability that these difficulties will be bridged over. At the same time, there is little chance of the extension of the arrangement to other departments of the steel trade. Among the combine arrangements which have come to grief is that of the International Association of Tube Makers, which had a brief, though, on the whole, useful career. The collapse is causing concern among tube makers, the competition in this branch having been of an intense character. The general fall in finished steel has been from £7 10s in October, 1907, to £6 10s at the present time. It will be seen that this is nothing like the amount of the fall in bars and billets already referred to.

Pig Iron.

The pig iron trade has been subjected to considerable vicissitude during the year. The selling price of No. 3 Cleveland at the middle of December was 48s 5d ($11.86), as compared with 50s 9d ($12.42) in April, last; 50s 9d ($12.42) in June; 51s 1d ($12.50) in August, and 52s 5d ($12.82) in September. The maximum of the year was reached in May, when the selling price reached 56s ($13.70), but this was due to a deliberate cornering of the market, and the movement in a single day collapsed, bringing down the prices 5s a ton. An element of

weakness in the market is the steady increase in stocks, which now approach 120,000 tons, an increase of about 70,000 tons since August. This year there has been a notable absence of the American buying, which in 1907 was the unexpected feature on the market, and rushed prices up to fancy figures. The fall in Midland pig irons has been much more marked than in those of Cleveland. The high-water mark of Northampton pig iron was reached in May, 1907, when 61s was realized. The decrease has steadily continued throughout the year, except for a short period in August and during November, when slight recoveries took place. This class of iron can now be had for about 46s per ton, and has been still lower. There has been a slight recovery of hematite, due to the improvement in steel, but the market is at present rather languid.

The trade has been seriously handicapped by the high price of coal, notwithstanding the comparatively poor demand for the mineral. The absence of foreign competition has enabled the colliery owners practically to control the market. At the same time, they profess themselves dissatisfied with the prices realized. Towards the close of the year the makers of finished iron were badly handicapped, owing to the steady rise in pig iron, representing an advance of 2s to 3s from the minimum, associated with a total inability to secure equivalent advances in finished iron.

Outlook More Hopeful.

The outlook for the new year is considered to be more hopeful, but there are many misgivings, owing to political unrest, and many capitalists attribute the lack of confidence to political causes, and especially to the influence which they allege the socialist section in Parliament has had upon legislation.

An important change has taken place under the Midland Wages Board in the raising of the premium. This was effected specifically in September last, when the premium was raised from 2s to 2s 3d per ton. This was due to extensive complaints on the part of the workmen that their wages, instead of being 6d in advance of those in the north, as they should be, to compensate for certain extras paid to northern workmen, were only 3d. The wages board arrangement is well known, the system of payment being that of 1s per ton for puddlers for every £1 in the selling price of iron, and an addition of 2s 3d premium. Under this board and the one in the north of England, peace has been continuously maintained throughout the British iron trade for a period of nearly 30 years. The relations between capital and labor throughout the trade are quite satisfactory, and are likely to continue so.

INDUSTRIAL PROGRESS HALTS IN REPUBLIC OF MEXICO

By Kirby Thomas.

The industrial and commercial conditions in Mexico, during 1908 were generally unsatisfactory, due mainly to the curtailing of the flow of foreign capital for investment, from American sources principally. The effect of the October panic was not felt in Mexico until after the first of the year, and similarly the resumption of activities has been delayed, although a general improvement has been noticeable for the last quarter of the year. The Mexican business in all lines is influenced by the continued low price of silver, the chief product of the country's most important industry, mining. During the year the Mexican government has practically completed the merger of the two trunk line railroads, the National and the Central, and secured by the interchange of government guaranteed stocks and bonds a control of the common stock in both these lines. A new high tariff on certain iron and steel products into Mexico became effective in August. This was designed avowedly to protect the Monterey Iron & Steel Co., the only large plant of the kind in the country. However, this plant is taxed to its full capacity, chiefly with work for the National railroad. The importation of iron and steel products has not been materially less than it would have been under the former low schedule. Under the impulse of the high tariff, plans are formed for the resumption of work on the iron and steel plant at Durango, which has been under litigation for some time.

During the year, the extent of the proven coal fields in northern Mexico has been greatly increased by exploration, and a tonnage estimated in the billions is claimed to be actually in sight for future operations. Important coal discoveries have been made in Oaxaca, which, it is claimed, will justify the development of an iron industry in southern Mexico, using the already known iron ore deposits of large extent and good grade. An attempt was made recently by the coal interests of Mexico to have enforced a discriminating freight rate against American coal, imported via Vera Cruz and Tampico. This matter is now under consideration by the authorities and the protection asked will probably be granted in part, although the metal mining and industrial interests have protested strongly.

The agitation of the new mining law, considered inimical to foreign interests, has interfered with the progress of general mining, and the resumption of foreign investment during the year. Recently President Diaz, acting under authority, struck out the objectionable clauses in the proposed law and recommended to congress a general mining measure, which is now before congress and will shortly be enacted.

There has been very little industrial progress in Mexico during the past year, owing to generally unfavorable financial conditions, but there is a prospect for a number of new enterprises during the coming year. The government is committed to the policy of a practically prohibitive tariff, for the benefit of established industries and congress has continued the authority of the executive to encourage new enterprises by exemption from taxes and custom duties on construction material. The American machinery manufacturers continue to hold the majority of trade in Mexico, but there has been during the year a noticeable increase of activity for Mexican trade on the part of the English manufacturers. Most of the mining interests of the republic are owned by Americans and the railroads and manufacturing institutions are generally managed by Americans. The natural resources of the country are largely undeveloped and the tendency at the present time is to establish facilities in Mexico for the utilization of the raw material, at least in its first stages.

HOPEFUL VIEWS OF BUSINESS PROSPECTS FOR NEW YEAR

MANUFACTURERS CONFIDENT THAT BETTER DAYS ARE COMING

Money Plentiful, Crops Have Been Good and Tariff Reduction is the Only Menace to Active Trade—Moderate Expansion Expected to Continue Until an Immense Volume of Orders Appears.

THE IRON TRADE REVIEW recently asked a number of prominent manufacturers and dealers in the iron trade for a brief statement of the outlook for business in the year 1909 as seen by them. The replies are almost without exception optimistic, and the writers give some very sound reasons for their belief that there will be a substantial return of prosperity in 1909.

Illinois Steel Co.

A review of iron and steel trade conditions prevalent during the year now about closing, and thought concerning what the immediate future holds, naturally lead one to a comparison of the present period with that of a year ago. In December, 1907, the iron and steel trade, together with all other lines of industry in this country, was in the midst of dark despondency incident to the severe financial convulsion through which the country had then recently passed. It was a period when manufacturers and merchants necessarily gave more thought to liquidation of accounts than to the question of new engagements. Business from the selling standpoint was in a state of lethargy, if not paralysis. Predictions, based upon past experience, were tainted with pessimism. Even those temperamentally inclined to look upon the bright side could discern but little hopefulness. Today financial adjustments have been successfuly completed, the stress of financial storm has passed, and the wheels of industry are turning in response to the pulse of a normal demand, coming from sound, economic underlying conditions. Under the guidance of sanity, steel manufacturers recognized a community of interest, took counsel one with another as to what was best for the general steel business, including the manufacturer, the merchant, the consumer and the employe. This policy resulted in avoiding demoralized market conditions and disastrous shrinkage in value of inventories which have followed previous periods of financial disorder. It has preserved a tendency towards stability in prices of steel products, from which all interests have benefited. Today there are no indications of any speculative tendency in the trade. Merchants and consumers are ordering in accordance with the actual necessities, and conditions are altogether wholesome.

The outlook for the future is certainly bright, the crisis is passed, and there exists a reasonable basis for the hope of a gradual return to normal trade conditions. Money is plentiful, opportunities for further expansion are great, and these two factors, unless interfered with by some unforeseen developments, will assuredly bring to the steel trade in the year 1909 a satisfactory volume of busines.

E. J. BUFFINGTON, President.

Chicago, Dec. 21.

The Pennsylvania Steel Co.

The setback of 1908 should enable steel makers to look forward to the future with a great degree of confidence. It was not possible that the increasing rate of production which obtained in preceding years could be maintained without constant menace to commercial stability. The break has come and resumption only awaits an assurance from Washington that the tariff question will be settled sensibly and promptly. American manufacturing plants were built and paid for at American protective rates for labor and materials, and are capitalized on that basis. They are built with high labor rates in view, and while the wages account per ton here and in Europe may in some cases be nearly the same, we necessarily have had to employ more capital to accomplish such a result. These facts must inevitably receive full consideration on the part of congress with satisfactory results to business.

The year 1908 witnessed the "irreducible minimum" of production. The future has better things in store, with the chances, as always in this country, favoring the optimist."

J. O. W. REYNDERS, Vice President.

Steelton, Pa., Dec. 21.

Jones & Laughlin Steel Co.

We look forward hopefully to the future. Business has improved very materially, and there is no reason why it should not continue. Much will depend upon orders placed by the railroads over the first six months, and our information is that a large tonnage will come out in the near future. It is possible that the tariff discussion in congress may retard business, but we hope and believe there will be no such radical departure from the protective principle as will materially effect either manufacturers or workmen.

WILLIS L. KING, Vice President.

Pittsburg, Dec. 17, 1908.

Eastern Steel Co.

The best that can be said for the recovery of the iron and steel industry from the unprecedented collapse of 1907 is that such recovery has been slow and halting, often conveying the impression of relapse. To my mind this proves that we are building a sound foundation for the vast prosperity that is in store.

Instead, however, of attempting prophecy in an effort to forecast when that prosperity must come, is it not better to briefly refer to the momentous changes that impend? These are:

First. Lower tariff duties. These in good times are a matter of indifference. In hard times low duties will work great injury. The foreign manufacturers are banded together for the conquest of our markets. They maintain, with governmental approval, high prices at home and they break prices here. Under the iniquitous working of the Sherman anti-trust law we cannot combine to retaliate. It is a duel in which our own people have dulled our blade.

Second. The exploitation of the vast iron ore deposits in Cuba. One company claims ore reserves exceeding five hundred million tons. Three others each can show deposits in excess of sixty million tons near the coast.

These with the dormant resources of the state of New York, if they do not shift the center of production to our eastern coast, will for an indefinite period supply the eastern producers. In addition to which the opening of the Panama canal will make available the great reserves of high grade iron ores on the west coast of Mexico. No one doubts our ample resources of good coking coals.

A. HECKSCHER.

New York, Dec. 22.

Wisconsin Steel Co.

Conditions in the steel business with us are moderately good. There has been some falling off in orders within the

last month, but the decline seems to be entirely natural with the approach of Jan. 1, when many manufacturing concerns are taking stock.

In talking with our trade we find them looking forward with confidence to favorable conditions in 1909, although our conservative friends are not looking for rapid increase in business but to a moderate expansion during the early part of the year, with conditions satisfactory to a reasonable judgment during the last half of 1909, provided the promise of summer is for crops of average abundance. We consider the outlook healthy and encouraging.

H. F. PERKINS, Manager.

Trenton, N. J., Dec. 21.

Richard Heckscher & Sons Co.

Our order book is filled for several months to come. Our plants are both running full, and we look for a steady and gradual improvement in business over the early portion of the coming year.

HERBERT W. GWYN, Secretary.

Chicago, Dec. 23.

The S. Obermayer Co.

As we all know, the conditions during the past year, beginning November, 1907, were trying ones to all those connected with the iron industry. Business in our line moved along very poorly in November, December and January, up to February, when it started to look better. The general sales of this company started to increase in March and from then on every month following was larger in sales than the preceding month, until it reached November, 1908, which was the best month since the depression started and brought the business within 80 per cent of its average normal condition with our concern.

Business continued to improve and the month of December, in the foundry business usually quiet, has been very active, probably the best December month that this company has had in its existence. The sales and the demand for goods have been very large this month and from the indications and from inquiries, the months of January and February will continue to increase in sales materially.

As to the prospects for the business and the general conditions, the writer is of the opinion that when the railroads begin to purchase, the iron industry will improve, and take on a boom.

The writer has also found from his experience that general stocks of merchandise connected with the iron industry are very low in the hands of the manufacturers and dealers and consumers, and should new business arise, it means the placing of new orders for new materials, the merchandise on hand having already been consumed. The writer believes that there will be a continued steady increase from now on, and probably by the middle of the year, 1909, business will practically be normal again.

H. F. FROHMAN, Manager.

Cincinnati, Dec. 21.

Scully Steel & Iron Co.

On account of the slump in October, 1907, Jan. 1, 1908, found the trade generally, both jobbers and manufacturers, very heavily overstocked and the working off of this great accumulation required a large portion of the year. The later months of the year show that practically this over-plus has been wiped out. The demand for the past three months has been quite excellent with every indication of a much heavier demand next year. Taking everything into consideration, the year 1908 has not been so bad, for it has permitted a checking up and clean-up which has prepared us all for the improved conditions which are very apparent, and the year 1909, without any question, will be highly satisfactory, which means that the following years of 1910 and 1911 will probably be the greatest in the history of the iron and steel business.

A. B. SCULLY, President.

Chicago, Dec. 22.

The William Tod Co.

From our view of the situation, general business, particularly in the smaller lines, appears to be fairly good; the least activity being in the heavy engine shops, and possibly among machine-tool and crane builders.

With the farmers prosperous, and a large amount of capital awaiting investment, we anticipate a marked increase of orders in our line within the next 60 to 90 days, and a volume of business fully up to the normal during the coming 12 months.

IRVING H. REYNOLDS,
Vice President.

Youngstown, O., Dec. 22.

John A. Roebling's Sons Co.

The business year of 1908 shows results as to output of manufactured goods entirely satisfactory to us after all conditions are taken into account. The volume of the production of this company is about 70 per cent of the year 1907; profits are not yet known, but they must have suffered materially because selling prices have been low and wages have not been reduced at all.

It will be a fair and reasonable proposition for manufacturers in every branch to obtain better prices for their goods during the year 1909; with a probable advance of prices in sight, buying is always stimulated and we look for this condition during the next year.

F. W. ROEBLING, Secretary.

Philadelphia, Dec. 21.

Alan Wood Iron & Steel Co.

While we are hopeful that business will improve and be better for 1909 than 1908, yet so much has been said about the return of prosperity that we would hesitate to enlarge further on this subject, but as I say, we are hopeful of better things.

J. R. JONES, Treasurer.

Philadelphia, Dec. 21.

The Columbus Iron & Steel Co.

We find business in pig iron slow in face of the holiday season, but anticipate increasing requirements after the new year opens.

J. G. BATTELLE, President.

Columbus, O., Dec. 21.

Grand Crossing Tack Co.

We are not expecting the year 1909 to be a banner year for iron and steel products. We, however, do expect that during the coming year there will be a vast improvement over 1908, especially in those lines which are contingent upon railroad purchases and general expansion of business. The development, however, towards greater prosperity will probably be intermittent and spotty.

O. N. HUTCHINSON, Manager.

Grand Crossing, Ill., Dec. 21.

Lukens Iron & Steel Co.

We are optimists on the outlook. We are not running full by any means, with only about 60 per cent, but we were down to 25 and 30 per cent some months ago. We do not think business will be full in our line for some months to come, but hope it will be by midsummer. We fully believe that the time is coming, and not far distant, when we shall not be able to supply the demand—when there will be a great shortage of cars and we shall all be at our wits' ends to know how to get the business through which is offered us. The increase is in a gradual and healthy manner which promises far better in the end.

A. F. HUSTIN, President.

Coatesville, Pa., Dec. 21.

The American Ship Building Co.

In common with all other industries, ship building during the current year has fallen below the average, but as a whole has been better than seemed probable one year ago, and as all conditions in our country are showing many indications of improvement, we look forward to an equal percentage of improvement in our industry. More and more each year, commodities of various kinds are seeking our lakes for transportation, and the growth of the country locally at and around the lakes, and throughout the great Northwest, war-

rants us in the belief that through the coming series of years there will be a large and growing lake trade that will demand modern tonnage, and a natural increase in construction, and while the coming year may not fully bring about normal conditions, we have reason to look forward to good, fair business improvement in our industry.

W. L. BROWN, Chairman.
Chicago, Dec. 22.

Empire Steel & Iron Co.

If present indications amount to anything, the serious depression, brought about by so many causes too well known to talk about now, is already a thing of the past, and beginning with Jan. 1, we look for a gradual, but steady improvement in all lines of business, for heavy sales of our product (pig iron) made over the last 60 days are already sufficient to run us in March, by which time I believe another buying movement will have already carried us well into the first half of the year, on a basis perhaps a little higher than the present schedule.

The only disturbing element, which may, but I trust will not, prevent what otherwise must be a condition of affairs that will enable all of us to make a fair showing to the different interests we represent, is the tariff question, and with that most important subject once behind us, readjusted on a fair basis, but not so radical as to call for abrogation of duties at one stroke, I anticipate nothing to warrant our expecting a repetition of dullness, such as has confronted the entire nation for some time past, but on the contrary, I believe every mill and factory will be running profitably and to the entire satisfaction of both labor and capital.

LEONARD PECKITT, President.
Catasauqua, Pa., Dec. 24.

Sharon Steel Hoop Co.

The manufacturers of steel hoops and bands cannot look ahead for increased tonnage, as the consumption of these finished lines has been very much affected by the temperance and local option movement. The rolling mills making steel hoops have probably not operated, on an average, during the past year, to more than 50 per cent of their capacity. The larger portion of this product goes into the manufacturing of cooperage and other packages, and this business has not alone been affected by the temperance movement, but it is also true that liquids that were formerly put up in barrels are now being transferred into tank cars, pipe lines, etc. Statistics show that the consumption of hoops is 30 per cent less than it was 10 years ago. These conditions, naturally are forcing the manufacturers of this finished product to take up other lines.

My opinion of the outlook for a good business next year in the general steel lines is that it is most encouraging. Some further adjustments of prices will be necessary. Scrap is much too high, as there is nothing to warrant its price being so much above that for pig iron. I believe that the present high price is due to the taking in of large stocks by the dealers, and this cannot long continue.

MORRIS BACHMAN, President.
Sharon, Pa., Dec. 21.

LaBelle Iron Works.

We firmly believe that unless congress assumes a decidedly menacing attitude towards present tariff rates, thereby disturbing the buyer's peace of mind, next year will show very satisfactory results, not only in the iron and steel, but other lines as well, and particularly so, should the railroad companies be able to so shape their financial affairs as to permit them to again become purchasers of much needed materials even on what might be termed less than a normal basis.

The manner in which settlements are now being made indicates a sound financial condition on the part of the customer, and this fact, coupled with low stocks in the hands of the jobbing interests together with an anxiety on the part of all to again be doing business on the 1906 and 1907 basis, certainly promises well for the future.

We are looking forward to next year very hopefully, and believe that our expectations in this respect will be fully realized.

ISAAC M. SCOTT, President.
Steubenville, O., Dec. 24.

HERE'S A HOT ONE.

Editor THE IRON TRADE REVIEW:

You ask me for a few words on the future of the iron trade. It is a great pity, just at this time, that when Dr. Osler was exploiting his chloroform theory he overlooked some people who have grown rich under protection and are now striving to tear it down.

W. G. POLLOCK.
Cleveland, Dec. 24.

Universal Portland Cement Co.

While this company is a subsidiary of the United States Steel Corporation, we are not, of course, engaged directly in the iron trade, and while to a great extent the conditions of the Portland cement business follow iron and steel, the waves of production and demand do not always coincide with other subsidiary companies.

We are closing a very successful year, having increased our capacity at Chicago and started our first plant at Pittsburg last January, and our total output will exceed 4,500,000 as against 2,000,000 barrels for 1907.

We look forward with perfect confidence to greatly improved conditions during 1909; our plants are running full, and we expect to turn out over 6,000,000 barrels next year.

As a sign of our faith in the future, we have secured since the election an appropriation for $2,400,000 to extend our Pittsburg plant to capacity of 10,000 barrels a day, which will give us a total output of over 8,000,000 barrels per annum. This increase we hope to have running the latter part of 1909.

EDWARD M. HAGAR, President.
Chicago, Dec. 22.

Inland Steel Co.

It is my opinion that business conditions are improving daily and gradually working toward normal. We should not look for any great increase to come about within the next month or so, but the demand for steel in the territory we serve—the great Mississippi Valley—is growing, and larger tonnages are being booked daily. The crop reports are all that could be desired. This, combined with the fact that it is doubtless only a question of a short time when the railroads will come more generally into the market for track material, equipment and other supplies, would reasonably justify the expectation that the steel capacity of this country will, by early spring, be pretty well engaged.

L. E. BLOCK, Vice President.
Chicago, Dec. 24.

The Lexington Motor Car Co., Lexington, Ky., which was recently incorporated with a capital stock of $50,000, has secured a site for its proposed plant on West Main street at the intersection of the Q. & C. railroad and the belt line, comprising three acres of land. Plans are being drawn for a substantial building to be supplied with machinery for the manufacture and repair of automobiles. The president of the company is Dr. F. F. Bryan, of Georgetown, vice president, Kinbae Stone, Georgetown; secretary and treasurer, Garrett D. E. Wilson, of Lexington.

EMINENT MEN OF THE IRON WORLD

X—James Gayley.

By B. S. Stephenson.

"The testimony of practical blast furnace managers, on both sides of the Atlantic, agrees that the dry-blast process reduces the cost of pig-iron about $1 per ton; but from the same testimony it also appears that this direct economy does not by any means cover its commercial advantages." This is the statement of an eminent metallurgical authority.

"During the eight years of its existence, the corporation's raw material resources have been proven, extended and developed, and the facilities for their recovery and transportation have been improved and systematized to such an extent that the operation of this vast department is now almost automatic." This is the testimony of one intimately acquainted with the affairs of the United States Steel Corporation.

These two unrelated statements suggest something of the accomplishments of James Gayley, lately resigned as first vice president of the corporation. They fail to take into account, however, a variety of other achievements which alone would insure him a place among the really creative engineers of the pig iron and steel industry. It is no slight distinction, for instance, to have revolutionized blast furnace practice in so far as fuels are concerned. It is a noteworthy attainment to have set unprecedented and unexpected records in pig iron output per ton of fuel consumed. The cheapness of handling iron ore from vessel to dock and from stock yard to furnace top, because of the wilderness of conveying machinery all along the southern shores of the lakes and in furnace yards, evidences the tremendous debt of the industry to the man who was largely instrumental in paving the way for its development. Election to membership in the British Iron and Steel Institute and for two years to the presidency of the American Institute of Mining Engineers comes only in recognition of some attainment through which the industry has recorded a substantial advance. Yet all this and more must be written into a relatively short career, for Mr. Gayley is leaving the corporation at the age of 53.

Influence of Instructors.

Out in the heart of the Lehigh valley iron district, at Lafayette college, in the early seventies, there were two instructors whose influence upon young Gayley was largely to shape all his later activities. One of these taught chemistry; his name was Thomas H. Drown, and he died one of the country's best known educators. It was through the chemical laboratory that Mr. Gayley made his entrance into blast furnace work. The other taught metallurgy; his name was Rossiter W. Raymond, now secretary of the American Institute of Mining Engineers. He has been a lifelong friend and associate of Mr. Gayley, who has shown the excellence of his early Lafayette training by his success in handling the corporation's ore properties.

Mr. Gayley was born at Lock Haven, Pa., where his father, Samuel A. Gayley, was a Presbyterian minister. The latter came of distinguished ancestry in the north of Ireland, and his maternal grandmother was a sister of Sir Henry Bell, famed for first establishing steam navigation on the Clyde. The boy was prepared at West Nottingham academy in Maryland and was graduated from the engineering department of Lafayette at the age of 20. Almost immediately, he entered the laboratory of the Crane Iron Co., at Catasauqua, Pa., and thus began a connection with iron and steel-making which has continued unbroken for over 30 years.

Rapid Advances.

From the start at Catasauqua, Mr. Gayley's rise was rapid. After an apprenticeship of three years with the Crane interests, he went to St. Louis as superintendent of the Missouri Furnace Co., a position which he resigned a little later to return to Pennsylvania and become manager of the blast furnaces for the extensive plant of the E. & G. Brooke Iron Co., at Birdsboro. This connection lasted until 1885, when he was placed in charge of the blast furnaces at the Edgar Thomson works in Braddock, which were then owned by the forerunner of the Carnegie Steel Co., the firm of Carnegie Bros. & Co., Ltd. Here it was that Mr. Gayley carried on the experiments and put into practice the theories of blast furnace practice which won for him world-wide recognition.

Before he had spent a half dozen years at the Edgar Thomson works, Mr. Gayley had set a new record for fuel economy, had demonstrated the needless wastes prevalent in the Pittsburg district, which thought the coal resources inexhaustible, and had shown the industry some new possibilities in point of tonnage produced in proportion to cubic capacity of stack and durability of linings. The heavy blast, employed principally because fuel was cheap, was replaced by a relatively low blast, and fuel consumption per ton of iron produced went down to a surprising extent.

From manager of blast furnaces, Mr. Gayley became manager of the entire Edgar Thomson plant, and, in 1899, managing director of the Carnegie Steel Co. Two years later, when the corporation was formed, he was one of the Carnegie associates to step into official position, and as first vice president assumed the monumental task of organizing and developing its ore and other raw materials and facilities for their transportation.

Mr. Gayley's association with the Edgar Thomson works covered that period of marvelous progress in iron and steel making when Braddock was setting the pace for operations on two continents. He worked with "Captain Bill" Jones and stood at his side when the breaking of a furnace wall closed the career of that king of steel-makers. At these works also were developed many of Mr. Gayley's most important devices for lowering the cost of pig iron production, among them the first charging bins for raw materials. There also he installed the first compound condensing engine for supplying the air blast, while another of his important im-

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[1]Other biographical sketches in this series are as follows: 1. John Fritz, Feb. 28, 1907; 2. Joseph Wharton, April 4, 1907; 3. Frank J. Hearne, July 4, 1907; 4. Hugh Bell, Aug. 8, 1907; 5. John J. Spearman, Sept. 5, 1907; 6. James M. Swank, Jan. 2, 1908; 7. Sir Alfred Hickman, Feb. 6, 1908; 8. Powell Stackhouse, May 14, 1908; 9. Jos. Sellwood, June 18, 1908.

provements was the bronze cooling plate for blast furnace walls.

The Dry Air Blast.

But it is through his successful development of the dry air blast that blast furnace practice owes its greatest debt to Mr. Gayley; and this so-called invention, though recognized by numerous and ample patent grants, was more in the nature of the successful solution of a century-old problem. The possibility and desirability of the dry blast were discussed a hundred years ago, and apparatus for accomplishing this end by cooling the blast was constructed not more than 50 years later. But these efforts uniformly ended in failure because of the fatal fact that the blast carried on with it into the furnace the moisture precipitated from it by the cooling process. As John Fritz once said: "We all thought it over and talked it over, but Mr. Gayley *did* it."

How Mr. Gayley "did it" is a matter of a good many years of experimenting. His principle, however, is simply this: By reducing the temperature of the blast to or below the freezing point of water, it is possible not only to precipitate but also to segregate the snow or ice thus formed and, in this solid state, to effect its practically complete removal. The blast constitutes more than one-half of the total weight of the materials charged into the furnace, yet ordinarily only scant attention is paid to the constant variation of its moisture content, even where every other material entering the stack is the subject of most careful analysis. With the substitution of a blast with a low and constant moisture content, the degree of control over the furnace's operation is naturally greatly advanced. An eastern interest which recently installed the system raised the percentage of product of a desired grade of iron from below 50 to above 80, and that with an antiquated stack and other disadvantages.

The Gayley Achievement.

Dr. Raymond recently told the American Institute of Mining Engineers just what Mr. Gayley did invent. As a summary, he said: "What we want is, first, to know just what we are putting into the furnace through the blast, and, secondly, how we can continue to do that particular thing practically without variation. Mr. Gayley, after years of costly experiment, has shown us, for the first time, how to attain this object, and I am not surprised that leading ironmasters, in this country and abroad, have recognized this invention as the greatest advance in blast furnace practice since the introduction of the hot blast by Neilson. It is scarcely too much to say that this invention, completing our mastery of conditions previously uncontrollable, has elevated the manufacture of pig iron from the category of processes which are partly art and partly accident to that of the true arts, which may be practiced with approximate scientific certainty."

Extensive plants for treating the blast under the Gayley process have been installed at several eastern furnaces, and valuable data on the results at the Warwick plant have been made public. During the past year, licenses have been granted for the equipping of nine western stacks and the very general adoption of the system now seems assured.

The Bessemer Adaptation.

Doubtless the most important development of the year in this connection was the successful adaptation of the principle to the Bessemer converter. This had long been one of the hopes of Mr. Gayley, but it was not until opportunities were afforded for carrying out the experiment on a commercial scale at the South works of the Illinois Steel Co. that the practical nature of this theory could be demonstrated. It was found that the lessened and constant moisture in the converter insures a better and more uniform grade of steel, that the blooms crop with sound ends under the usual manufacturer's discard, that this steel rolls into better rails with a reduction of seconds, and that the control of low or high silicon irons is enlarged.

The testimony of P. H. Dudley, the rail expert, who was frequently at the works while the experiments were under way, is that the application of the dry blast "is a great step in advance for the Bessemer process from every standpoint of consideration and practical operation." Following up these exhaustive trials, a permanent installation for use in connection with the Bessemer department is now being made at the South works, and the success of the innovation is further evidenced by the granting of licenses for equipping two blast furnaces and a converter at Die Gewerkschaft Deutscher Kaiser, Hamborn. There is every reason to believe that the success of the dry air blast in steel making will prove an important assistance to the Bessemer process in maintaining its own against the ascendancy of the open-hearth. Mr. Gayley is not one of those who predict its early doom.

"The Bessemer process will prevail just as long as there are Bessemer ores," he said, recently, "and there is no predicting when they will be exhausted. The deposits recently discovered in Cuba, for instance, are very largely Bessemer. That steel, for certain purposes, is superior to any other, and its manufacture will be continued as long as suitable ores are obtainable."

ANNUAL REPORT OF THE COMMISSIONER OF PATENTS FOR 1907.

The annual report submitted by Edward B. Moore, commissioner of patents, contains the regular yearly account of business of the patent office. Mr. Moore recommends, because of the great amount of accumulated work and the great volume of work which is constantly coming in, increasing each year and keeping pace with the growth of the country and the activities of manufacturers and commerce, that a sufficient number of clerks and examiners be added to the present force to enable them to bring the arrearages up to date and dispose promptly of the great amount of incoming work. He also submits for the consideration of Congress proposed amendments to the law relating to appeals in the patent office. The purpose of the first of the proposed amendments is to shorten the course of prosecution of applications on appeal by the elimination of one of the appeals within the office; that of the second is to make the class of cases relating to trade marks conform to the course recommended in the above first amendment by substituting a proposed board of appeals for the commissioner as the appellate tribunal of the office.

From a statement of the money receipts for the year 1907 the commissioner has shown that the recent financial depression had no effect whatever on the business of the patent office, the increase of the surplus of 1907 over 1906 being $43,129.60. During the year 1907 patents to the number of 36,620 were granted from the number of 58,762 applications. From July 28, 1836, to Dec. 31, 1907, there have been issued a total of 2,749,471 patents to United States citizens and foreigners inclusive.

BLAST FURNACE CAPACITY CONTINUES TO GROW

Present Capacity Nearly 30,000,000 Tons; Prospective Capacity Exceeds 32,000,000 Tons; Nine New Furnaces Blown In During 1908, With 1,000,000 Tons Capacity

By B. E. V. Luty.

The capacity of blast furnaces in the United States in actual operative condition on Jan. 1, 1909, can be stated, by a conservative estimate, to be in excess of 29,300,000 gross tons a year, while the prospective capacity, including furnaces now almost completed and others well under way by thoroughly responsible interests, is easily in excess of 32,000,000 tons.

Estimates of existing or prospective blast furnace capacity have sometimes been made on the basis of ratings, and including all furnaces which had not been definitely abandoned, and these were naturally in excess of the production which could actually be made under ordinary industrial conditions. Such estimates, being excessive, have sometimes tended to make the trade suspicious of such summary statements. It should be said at the outset, therefore, that the estimates here given are based upon actual performance, and will be supported by data which will leave no possible room for criticism of the results, unless there should be criticism that the estimates of totals are too low. It is desired to be conservative, but not to introduce so much conservatism as to lead to actual and important error.

Last Year's Crop of New Furnaces.

In a review of the building of new blast furnaces in The Iron Trade Review for Jan. 2, 1908, it was remarked, with respect to the large number of blast furnaces which had been put under construction, that the industrial depression would somewhat delay the blowing in of such new furnaces. Taking account of the large number of furnaces then being built, there has been considerable delay, but the crop of new furnaces in 1908 has really been fairly large, there being nine furnaces, with an annual capacity slightly exceeding a million tons.

Before giving a list of these new furnaces, it is well to repeat what was said a year ago, that these summaries include only absolutely new blast furnaces. They take no account whatever of improvement to existing furnaces, or of the complete rebuilding of furnaces. To gain a place in these computations, a furnace must be an absolutely new one, on a new site, unless, as sometimes happens, some old furnace has been absolutely abandoned for years, and it chances that a new furnace is built in the same location. For example, there was a furnace blown in May 27, 1906, an absolutely new furnace, but it was by a company which had abandoned two antiquated furnaces in 1904 and 1905, so this furnace was not included. The nearest approach to the inclusion of a rebuilt furnace in these lists is the case of one which was blown in during 1905, and used some machinery of an old furnace, 50 miles away, which furnace had not operated since 1892.

It is recognized that furnaces are continually falling by the wayside, and no summary which includes all furnaces in existence can come within striking distance of the real capacity, under normal business conditions. Thus the summary in the 1904 Iron and Steel Works Directory gives a total capacity of 28,114,000 tons, but in the following year, when there was an excellent demand for all pig iron that could be sold at anything like a reasonable price, and when many new furnaces had been completed, the actual production fell short of 23,000,000 tons. The fault lay in part with oversanguine estimates of individual capacity, but the discrepancy was due chiefly to the fact that there were many furnaces in actual existence whose owners would not consider them abandoned but which nevertheless could not produce economically. Then, too, estimates of furnace capacity do not always take time out for accidents and relining. Again, the latest directory lists, as of Nov. 1, 1907, furnaces rated at 34,833,900 tons a year, but the furnaces could not possibly make so much iron in a given year. These figures are cited partly by way of contrast, as the summaries to be developed in this article have an entirely different basis, being predicated upon pig iron actually produced and officially reported as the output for given half-years.

It is assumed sometimes that new furnaces must be built to take the place of obsolete furnaces. It is true there must be new erection, or improvement, but data will be presented which show conclusively that the rebuilding and improving of existing furnaces is a very large item, much more than enough to take care of obsolescence, whereby production increases by a greater rate than would be dictated simply by the advent of new furnaces. For example, should one take the actual production in the first half of 1907 and deduct from that the estimated make of all new furnaces blown in after the middle of 1905, he would find that the production was much larger than the production in the first half of 1905, although market conditions were not especially dissimilar. The furnaces which were running in the first half of 1905 increased their make.

New Furnaces.

The crop of absolutely new furnaces blown in during 1908 has been as follows:

April 30: Vanderbilt No. 2, Boyles, Ala.; Birmingham Coal & Iron Co.; stack 80 x 18 feet; annual capacity, 80,000 tons.

Aug. 22: Miami, Hamilton, O.; Hamilton Iron & Steel Co.; stack 80 x 18 feet; annual capacity, 100,000 tons.

Oct. 4: Jisco, Jackson, O.; Jackson Iron & Steel Co.; stack 75 x 17 feet; annual capacity, 28,000 tons of 8 to 12 per cent silicon iron.

Oct. 16: Harriet, Buffalo, N. Y.; Wickwire Steel Co.; stack 80 x 19 feet; annual capacity, 100,000 tons.

Nov. 2; A, Youngstown Sheet & Tube Co., Youngstown, O.; stack 88 x 22 feet; annual capacity, 180,000 tons.

Nov. 21: Ironton, O.; Ironton Iron & Steel Co.; stack 75 x 18 feet; annual capacity, 80,000 tons.

Nov. 23: B, Youngstown Sheet & Tube Co., Youngstown, O.; stack 88 x 22 feet; annual capacity, 180,000 tons.

Dec. 21: Gary No. 9, Gary, Ind.; Indiana Steel Co.; stack 88 x 21½ feet; annual capacity, 150,000 tons.

Dec. — : Gary, No. 10, duplicate of the above, was scheduled for blowing in before Jan. 1, and is included as legitimately a part of the 1908 furnace crop even though the date cannot be given.

The nine furnaces listed above have a rated capacity of 1,048,000 tons a year.

Furnace Types in Recent Erection.

The development of blast furnace lines is a long story. There have been progressions and retrogressions in size, and changes in shape. At no time has it been well to say that progress is over. Sometimes such statements have been made, but further development has followed. The one development which has more promise of fixedness than any

other is the divergence in the lines of the furnace according to the character of the output. It is largely in the past few years that the furnace for producing steel making iron and the furnace for producing foundry iron have become far separated in their lines.

It becomes a matter of interest to study the proportions of different furnaces lately built in order to obtain a picture of the present ideas of blast furnace engineers, and the table which the discussion of capacities makes necessary in any event has been expanded to show the size of furnaces built in the past four years. Enough description is given to enable those interested to identify the furnace.

There are listed 43 furnaces in the above table. Three of them do not lend themselves to classification, Palmerton being built to use zinc residium, Bethlehem having a prospect of Cuban ores and Jisco being intended to produce high silicon iron. Of the remaining 40, three are in the south; they are 80 x 18, 85 x 20 and 86 7-12 x 20¾ respectively. There are two charcoal furnaces, 60 x 10½ and 60 x 12. There remain 35 furnaces, of which 26 are steel works furnaces and nine are merchant furnaces.

Comparing roughly these two groups of furnaces, it may be said that of the 26 steel works furnaces only five have a bosh diameter less than 21 feet, while all but one of the nine merchant furnaces have a less bosh diameter than 21 feet. There is but one steel works furnace as small as 80 x 19 while all but three of the nine merchant furnaces are smaller than this.

In the steel works furnaces, the most common bosh diameter is 22 feet, there being 13 of this diameter, while three others are 21½ feet, making a total of 16 which are approximately of this size. Of the 16, seven are 85 feet high, five are 90 feet and four are 88. That establishes a type pretty well. The 16 in question, it may be noted, are, of the Steel Corporation, two Donora, two Carrie, two Lorain, two Gary, one Mingo, one South Works and one Joliet, and of the independents, two Youngstown Sheet & Tube Co., one Cambria and one Lackawanna.

Three Lackawanna furnaces are larger, being 94 x 24, but they are not the last built in the Lackawanna group. Monongahela D, of the National Tube Co., is 90 x 23. The remaining six steel works furnaces are smaller than 21½ or 22 feet bosh diameter, one being 21 feet, two 20½ feet, one 19½ feet and one 19 feet, all being 85 feet high with the exception of the one with the 19-foot bosh, which is 80 feet high.

Of the nine merchant furnaces, one is 85 x 21, three are 80 x 20 and the remainder straggle along at 75 x 18½, 80 x 18, 75 x 18, 77 x 17 and 75 x 17, there being only one of each size.

Increasing Output of Old Furnaces.

It was said at the outset that the estimates of capacity given were based on actual performance, and later on it was remarked that the capacity of new furnaces coming in does not need to be discounted on account of old furnaces, becoming obsolete, because the rebuilding or improving of most old furnaces more than makes up for the comparatively few that go out of business. The evidence upon which these statements were based will now be given, having reference to the table of new blast furnaces which came in during the past four years.

By a simple chart it is possible rapidly to estimate the output of a new furnace up to the end of the half year during which it comes in, and making allowance for its not getting its full output at the start. For each group of furnaces coming in during a given half year the output for that half year has been estimated, while it

Entirely New Furnaces Blown in, 1905-8.

Date Blown in	Name of Furnace.	Location.	Size.	Annual Capacity.
1905				
Jan. 1,	Pine Lake	Boyne City, Mich. (Chl.)	60 x 10½	29,000
Jan. 3,	Donora No. 1	Donora, Pa.	85 x 22	150,000
Jan. 21,	Lackawanna, No. 4	Buffalo, N. Y.	94 x 24	180,000
Feb. 7,	Donora, No. 2	Donora, Pa.	85 x 22	150,000
Feb. 22,	Lorain D	Lorain, O.	85 x 22	150,000
April 28,	Ensley, No. 6	Ensley, Ala.	87 x 20¾	100,000
June 23,	Woodward, No. 3	Woodward, Ala.	85 x 20	90,000
July 5,	Buff.-Susq., No. 2	Buffalo, N. Y.	80 x 20	113,000
Sept. 3,	Lackawanna, No. 5	Buffalo, N. Y.	94 x 24	180,000
Dec. 28,	Monongahela D	McKeesport, Pa.	90 x 22	150,000
		Total in 1905, 10 furnaces		1,292,000
1906				
Jan. 17,	Cambria, No. 7	Johnstown, Pa.	85 x 22	150,000
Jan. 21,	Mingo, No. 4	Mingo Junction, O.	90 x 21½	145,000
March 6,	Cadillac	Cadillac, Mich. (Chl.)	60 x 12	40,000
May 1,	Lackawanna, No. 6	Buffalo, N. Y.	94 x 24	180,000
June 21,	South Works E	South Chicago, Ill.	90 x 22	160,000
Sept. 2,	Joliet, No. 4	Joliet, Ill.	90 x 22	150,000
Sept. 3,	Palmerton, No. 2	Palmerton, Pa.	70 x 14	20,000
Sept. 6,	Midland	Midland, Pa.	85 x 21	150,000
Oct. 3,	Haselton, No. 3	Youngstown, O.	85 x 20½	140,000
		Total in 1906, 9 furnaces		1,135,000
1907				
Jan. 1,	Haselton, No 3	Youngstown, O.	85 x 20½	150,000
Jan. 5,	Toledo, No. 2	Toledo, O.	80 x 20	135,000
Jan. 14,	Josephine	Josephine, Pa.	80 x 20	140,000
Feb. 1,	Federal, No. 1	South Chicago, Ill.	75 x 18½	110,000
Feb. 12,	Lackawanna, No. 7	Buffalo, N. Y.	85 x 22	180,000
April 15,	Bethlehem E	South Bethlehem, Pa.	90 x 22	140,000
May 2,	Mayville B	Mayville, Wis.	77 x 17	90,000
May 2,	Minnequa F	Pueblo, Colo.	85 x 20	125,000
June 4,	Carrie No. 6	Rankin, Pa.	85 x 22	160,000
June 16,	Perry	Erie, Pa.	75 x 17	100,000
Aug. 3,	Carrie, No. 7	Rankin, Pa.	85 x 22	160,000
Aug. 7,	Cambria, No. 8	Johnstown, Pa.	85 x 21	150,000
Aug. 30,	Inland	Indiana Harbor, Ind.	85 x 19½	125,000
Sept. 26,	Lorain E	Lorain, O.	90 x 22	150,000
Oct. 10,	Monongahela D	McKeesport, Pa.	90 x 23	150,000
		Total in 1907, 15 furnaces		2,065,000
1908				
April 30,	Vanderbilt No. 2	Boyles, Ala.	80 x 18	80,000
Aug. 22,	Miami	Hamilton, O.	80 x 18	100,000
Oct. 4,	Jisco	Jackson, O. (Silicon)	75 x 17	28,000
Oct. 16,	Harriet	Buffalo, N. Y.	80 x 19	100,000
Nov. 2,	Furnace A	Youngstown, O.	88 x 22	180,000
Nov. 21,	Ironton	Ironton, O.	75 x 18	80,000
Nov. 23,	Furnace B	Youngstown, O.	88 x 22	180,000
Dec. 21,	Gary, No. 9	Gary, Ind.	88 x 21½	150,000
Dec. —,	Gary No. 10	Gary, Ind.	88 x 21½	150,000
		Total in 1908, 9 furnaces		1,048,000

is of course assumed that during the following half year the furnaces will turn out their full rating.

Starting with the beginning of 1905, it will be recalled that the increase in demand towards the close of 1904 brought in a full measure of the old furnaces, while some new furnaces which had long been completed, but which had lain idle, were blown in. The output in the first half of 1905 may be taken as substantially as large an output as could be made by the existing furnaces. The actual output, as officially reported, was 11,163,175 tons in the first half of 1905. The new furnaces blown in during the half year are estimated to have contributed 281,000 tons to the half year's output, while running for a full half year, as they would in the second half, their capacity was 424,500 tons. Then we have the following:

Actual output, first half 1905..	11,163,175
Contribution of first half furnaces	281,000
Make of old furnaces.....	10,882,175
Capacity of first half furnaces	424,500
Contribution of second half furnaces	107,000
Prospective make, second half 1905	11,413,675
Actual make	11,829,205
Excess in half year.....	415,530

Thus it will be observed that the actual production in the second half of 1905 was 415,000 tons more than would naturally have been expected, assuming that the old furnaces had done as well as they could in the first half, and allowing for the new furnaces.

Taking advantage of the increase shown, let the same computation be made again, to see what should have been expected for the first half of 1906:

Actual output, second half 1905	11,829,205
Contribution of second half furnaces	107,000
Make of old furnaces.....	11,722,205
Capacity of second half furnaces	221,500
Contribution of first half furnaces	155,000
Prospective make, first half 1906	12,098,705
Actual make	12,582,250
Excess in half year.....	483,545

Again the furnaces did much better than expected, although we started this second computation on the basis of the gain already shown. The gain just found is a fresh one; there is nothing cumulative. Pursuing the computation for another half year we find:

Actual output, first half 1906.	12,582,250
Contribution of first half furnaces	155,000
Make of old furnaces.....	12,427,250
Capacity of first half furnaces	337,500
Contribution of second half furnaces	126,000
Prospective make, second half 1906	12,890,750
Actual make	12,724,941
Deficiency in half year.....	165,809

In this case the furnaces did not come up to expectations, but the drop is slight compared with the heavy gains previously made. Going forward for another half year we have:

Actual output, second half 1906	12,724,941
Contribution of second half furnaces	126,000
Make of old furnaces	12,598,941
Capacity of second half furnaces	230,000
Contribution of first half furnaces	361,000
Prospective make, first half 1907	13,189,941
Actual make	13,478,044
Excess in half year.....	288,103

It is a rare thing for the existing blast furnace capacity to be pushed for so long a time that the actual performances can be compared, but it is certainly justifiable to assume that from the close of 1904 until the second half of 1907 was half over the existing blast furnace capacity was pushed, and that the actual make in each half year represented substantially what it was possible for the furnaces, as a whole, to do. In the second half of 1905, the furnaces made 415,000 tons more than would have been expected, considering the first half output; in the first half of 1906, they made a further gain of 484,000 tons; the next half year they fell back 166,000 tons, but in the next they gained 288,000 tons. The net gain in the whole time was 1,021,369 tons, in a half year period, or say 2,000,000 tons a year.

In other wards, if we eliminate from the reckoning, as best we can, all the new blast furnaces which were blown in from Jan. 1, 1905, through 1907, the old blast furnaces appear to have made pig iron at a rate 2,000,000 tons a year greater in the first half of 1907 than they did in the first half of 1905. In large part it is evident that the gain was achieved through the rebuilding and otherwise improving of a great many furnaces, while of course the furnaces were driven harder.

Possible Output in 1907.

Inasmuch as production slumped off so suddenly in the two closing months of the year, it has sometimes been wondered what the production would have been had capacity been pushed clear through the year. Had the chance of the calendar been different, the year 1907 would have made quite a different showing. There were new furnaces being blown in right to the end of the high pressure period, one, indeed, coming in on Oct. 10. It is easy to estimate what 1907 could have shown:

Actual make, first half 1907..	13,478,044
Contribution of first half furnaces	361,000
Make of old furnaces.....	12,117,044
Capacity of first half furnaces	665,000
Contribution of second half furnaces	224,000
Prospective made, second half 1907	14,006,044
Actual make, first half.....	12,478,044
Possible total make, 1907....	27,484,088

That possible make is just 1,700,000 tons more than the calendar year 1907 actually did contribute, and if the curtailment of output had commenced two or three months later there is no doubt that the iron would have been made.

Present and Prospective Capacity.

It seems perfectly fair to forecast our prospective capacity on the basis of what the furnaces actually did in the first half of 1907, the last half year in which they were under pressure, adding to that record for the new furnaces which have come in and are to come in. Of course some one will say that the furnaces could not keep up the gait; they have to be relined, and that sort of thing. However, it does not take a particularly long memory to recall that this very thing was said early in 1906 and at other times, but demand kept up and the furnaces did not play out, but on the contrary, as shown above, they kept on making more and more iron than would have been expected of them. If the computation made above had been made in July, 1905, showing how much iron ought to be made in the second half of that year, there would have been sensitive spirits who would have suggested that it could not be done, but the fact is that the furnaces ran at 800,000 tons a year more than the computation would have shown. Thus it has gone,

half year after half year, and thus it is reasonable to expect it will go if the furnaces are put under the necessary pressure, and that pressure, it is claimed, will be produced in the course of time by the maintenance of prices for finished steel products. Should they not be maintained, there is, of course, a different story, since a few furnaces, but not so many, might fall by the wayside on a very close price basis.

The actual production of pig iron in the first half of 1907 was 12,478,044 tons, and furnaces which blew in at various times during that half year are estimated to have contributed 361,000 tons, leaving 12,117,044 tons, as the make, during the first half of 1907, of furnaces which were in existence before Jan. 1, 1907. Double this is 26,234,000 tons, so that we can proceed as follows:

Capacity, Jan. 1, 1907	26,234,000
New furnaces, first half	1,330,000
Capacity, July 1, 1907	27,564,000
New furnaces, second half	735,000
Capacity, Jan. 1, 1908	28,299,000
New furnaces, first half	80,000
Capacity, July 1, 1908	28,379,000
New furnaces, second half	968,000
Capacity, Jan. 1, 1909	29,347,000
Furnaces building by Steel Corporation	1,630,000
Furnaces building by independents	1,530,000
Prospective capacity	32,507,000

The Furnaces Being Built.

A list is given below of new furnaces being built, and which are taken account of in the table above. The list may err on the side of not being complete, but it does not err on the side of including any furnaces which are unlikely to be built. Any furnace project arising, or adhered to, in times like those through which the iron trade has been passing may be taken as an entirely sound one. The list is particularly conservative in such cases as the Aliquippa operation; four furnaces are to be built there, but three are nearly completed and the fourth is far behind, so only three are included in the list.

Many of these furnaces are almost completed, and can be blown in very shortly, if necessary. For the eight Gary furnaces (two of which are blown in) the money has been appropriated and is held ready to pay the bills.

United States Steel Corporation:	
Two Duquesne	365,000
Two Ohio	365,000
Six Gary	900,000
Total	1,630,000
Independents:	
New York State Steel	150,000
International Harvester	140,000
Federal Furnace B	125,000
Cleveland Furnace, No. 2	150,000
Hanna interests, Buffalo, two	300,000
Aliquippa, three	525,000
Corrigan, McKinney & Co., one at Cleveland	150,000
Total	1,540,000

There is no reason to suppose that an estimate of 32,500,000 tons a year as our prospective capacity when the present new erection program has been carried out is not conservative. The improvement of old furnaces is being continued and some are being entirely rebuilt. The more general introduction of the Gayley dry blast will also help. Of these influences, the estimate of 32,500,000 tons takes no account.

RAILROAD CONSTRUCTION WAS AN IMPORTANT FACTOR

In Relieving Depression in Canada, Where Financial Troubles Were Felt as in the United States

By Phillips Thompson.

Toronto, Canada, Jan. 1, 1909.—Canada has shared in the general depression in industry prevalent throughout the continent during 1908. The opening of the year found manufactures generally slack, with some establishments closed and production greatly curtailed, but strong expectations were entertained that the spring would witness a revival. These anticipations unfortunately were not realized and while there has been some increase in activity, conditions have continued dull throughout the year in most lines. Early in the period of depression, the banks adopted a conservative policy in regard to advances. They discouraged expansions and largely restricted credits to the current market requirements. Consequently outputs have been generally limited to the filling of orders in hand and there has been little disposition or ability to anticipate the market. These conditions, while applicable to manufacturing industries in general, were felt perhaps more severely in the iron trade, as the depression in other lines and the postponement of expansions and contemplated enterprises greatly lessened the demand for machinery and structural material.

Antagonism to Corporations.

Another factor in the situation has been the growing antagonism to corporations in connection with public utilities, which has taken practical form in the Hydro-Electric Power system of the Ontario government for supplying the cities and towns of western Ontario with electric energy from Niagara Falls in opposition to chartered companies. Whatever may be its ultimate benefits as a means of cheapening power to the manufacturer, one result in the meantime has been to deter private capitalists from engaging in enterprises of a semi-public character, which might otherwise have been undertaken.

The saving feature of the situation, without which the depression would have been much more severe, has been the great activity in railroad construction in western Canada and the large amounts spent in the equipment of the Canadian Pacific, Grand Trunk Pacific and Canadian Northern. The building of the Grand Trunk Pacific has made good progress during the year, and the completion of the branch line from Fort William to Superior Junction and the bridge over Battle river, Alberta, will greatly facilitate the forwarding of material and supplies to the sections under construction and enable the contractors to push the work more rapidly next season.

The building trade, which was very quiet during the earlier part of the year, became active later in the season, causing a fair demand for hardware and structural steel, which is likely to continue in the spring.

Harvest Conditions.

The expectation that an abundant harvest in the west would have a de-

cided effect in stimulating trade and inducing large orders from that quarter was not fulfilled. As the result of a period of prosperity and a great influx of immigration, western values had been considerably inflated and markets overstocked, and while the generous harvest averted a serious crisis and put business on a sounder basis by enabling debtors to meet their obligations, it did not result in the expansion of business anticipated. The outlook is favorable for an increased demand from this market on the opening of spring, though a feature which must not be overlooked is the inevitable tendency to establish home industries in the western cities, rendering the prairie provinces less dependent in the future upon the manufacturers of Ontario and Quebec. With the passing of the depression and the completion of railway facilities, a considerable expansion in the iron industries of Winnipeg and other western centers may be looked for, in the near future.

The agricultural implement industry has held its own better than most other lines though with a somewhat lessened output. In contrast with most departments of industrial production, the exports of Canadian agricultural implements have materially increased during the year. The latest returns available show a total value under this head of $1,622,745 for the five months ending with August last, as against $1,160,682 for the corresponding five months of 1907.

Among the noteworthy developments of the trade during 1908 have been the securing of orders for steel rails by the Dominion Iron & Steel Co., of Sydney, N. S., from India, Australia and Mexico, which has enabled the works to remain in continuous operation when domestic contracts were not forthcoming; and the merger of a number of interests controlling iron plants in Quebec, Ontario and Nova Scotia in the Canada Iron Corporation, in which British capital is largely interested.

THE CONNELLSVILLE COKE INDUSTRY DURING 1908.

With the last week estimated, the total production of coke in the Connellsville regions in 1908 as compiled by the Connellsville *Courier* was 9,581,441 tons compared with 19,738,873 tons in 1907 or a decline of 10,157,432 tons. The total number of ovens in the region Dec. 19 was 37,856 against 35,617 in 1907, or an increase in capacity of 2,239 ovens.

The year began with production at the low ebb, and this gradually increased over the year until about 57 per cent of capacity was active toward the close. The drouth which came upon the regions in the latter part of the year, while curtailing operations with those plants unfavorably located with respect to water supplies did not have a marked effect upon the market owing to the sufficient capacity available to supply all demands. Prices in the year were generally low, but strengthened as consumption increased.

The largest coke transaction of the year was the purchase by the Wisconsin Steel Co. of 12,000 tons of furnace coke monthly for three years beginning Jan. 1, 1909. One of the large implement makers also took 30,000 tons of foundry coke in one lot.

The average monthly prices on spot coke over the year were as follows:

	Furnace	Foundry
January	$1.80	$2.40
February	1.75	2.35
March	1.70	2.20
April	1.65	2.10
May	1.65	2.00
June	1.65	2.00
July	1.65	2.05
August	1.65	2.00
September	1.65	2.00
October	1.70	2.00
November	1.75	2.10
December	1.80	2.15

Production of Coke.

(Compiled from weekly reports of *Connellsville Courier*.)

Week ending—	Total Ovens.	Ovens in blast.	Ovens out of blast.	Production tons.
Jan. 4	35,735	12,610	23,125	128,838
Jan. 11	36,158	14,118	22,040	142,346
Jan. 18	36,158	14,469	21,689	143,838
Jan. 25	36,157	17,441	18,716	208,762
Feb. 1	36,299	17,737	18,562	215,560
Feb. 8	36,299	17,670	18,629	185,375
Feb. 15	36,455	17,858	18,597	189,018
Feb. 22	36,493	17,869	18,624	180,948
Feb. 29	36,584	16,720	19,864	157,982
Mar. 7	36,590	17,090	19,500	158,824
Mar. 14	36,590	16,837	19,753	160,369
Mar. 21	37,488	16,944	20,544	160,085
Mar. 28	37,584	15,648	21,936	139,663
Apr. 4	37,530	14,100	23,430	132,418
Apr. 11	37,474	14,251	23,223	147,148
Apr. 18	37,474	14,265	23,209	147,786
Apr. 25	37,474	14,231	23,243	164,858
May 2	37,473	14,065	23,408	166,175
May 9	37,473	14,655	22,818	173,045
May 16	37,473	14,658	22,815	173,082
May 23	37,385	14,369	23,016	169,888
May 30	37,405	14,773	22,632	153,202
June 6	37,405	14,828	22,577	155,846
June 13	37,359	15,306	22,053	162,947
June 20	37,375	15,340	22,035	162,404
June 27	37,375	15,362	22,013	164,839
July 4	37,375	16,225	21,150	165,472
July 11	37,445	17,527	19,918	174,729
July 18	37,459	17,903	19,556	185,093
July 25	37,472	18,010	19,462	188,799
Aug. 1	37,517	18,156	19,361	189,423
Aug. 8	37,350	18,152	19,198	192,845
Aug. 15	37,350	18,196	19,154	193,492
Aug. 22	37,430	18,242	19,188	196,144
Aug. 29	37,470	18,428	19,042	200,823
Sept. 5	37,470	17,751	19,719	192,214
Sept. 12	37,470	17,967	19,503	195,974
Sept. 19	37,470	18,213	19,257	201,485
Sept. 26	37,486	18,486	19,000	198,239
Oct. 3	37,486	18,496	18,990	199,074
Oct. 10	37,561	18,252	19,309	201,713
Oct. 17	37,632	17,621	20,011	198,315
Oct. 24	37,630	17,427	20,203	188,939
Oct. 31	37,885	18,320	19,565	223,987
Nov. 7	37,893	18,570	19,323	230,559
Nov. 14	37,893	18,389	19,504	228,190
Nov. 21	38,020	19,154	18,866	220,145
Nov. 28	38,020	19,829	18,191	229,199
Dec. 5	37,850	20,357	17,493	235,211
Dec. 12	37,853	21,333	16,520	244,309
Dec. 19	37,856	22,061	15,795	251,903
Dec. 26	37,842	22,477	15,365	207,853
				9,579,375

THE WORKS OF THE INDIANA STEEL CO. AT GARY, IND.

The First of a Series of Articles Describing the Great Plant Which the Steel Corporation is Building on the Shore of Lake Michigan—The Present Article is Descriptive of the Blast Furnace Equipment.

With the blowing in of furnace No. 12 at the Gary plant of the Indiana Steel Co., on Dec. 21, there was inaugurated an open-hearth steel making operation to which a world-wide attention has been given. The beginnings of interest in this plant centered around the decision to erect a steel works for the sole manufacture of open-hearth steel. The conception of what this plant should be and the authorization which made that vision a reality are most inspiring and most noteworthy among all the things for which Gary has commanded attention. There was placed at the disposal of the builders, unlimited means promptly available, a large freedom in which to choose the most suitable site, tabulated records of the best mill practice and experience and a splendid organization from which to draw assistance. Nothing short of a complete development of the possibilities of this situation would have been accepted by the engineers as creditable to themselves. In its elements the Gary plant is not experimental. Two notable practices, in which there has been much investigation, the dry blast and the by-product coke ovens, are still in the experimental stage and both are thus far lacking among the adjuncts of the Gary plant. The future incorporation of these and other methods has been provided for when it shall appear desirable. The innovations installed which are looked upon as experimental and which are attracting the serious interest of engineers, are the several individual problems involved in the application of methods, heretofore proven practical in small units, to the very large scale upon which Gary is laid out. Particularly does this interest attach to the operation of the power plants and the rail mill.

The entire Gary plant is to be driven by individual induction motors, located wherever power is required. Current is carried at high voltage on an intricate distributing system from a central power house. Here in one building is the driving plant upon which complete dependence is placed for the operation of the various machinery and mills. The electric generators here installed are driven entirely by gas engines using blast furnace gas. The same motive power is used for the blowing engines for the blast furnaces. The use of blast furnace gas for power purposes is an established practice, including the methods installed at Gary for washing the gas, but such installations as comprise the two blowing engine plants and central power house in which are a total of 33 twin-tandem gas engines aggregating a combined rated capacity of 108,000 horsepower, are without parallel. In this country, at least, this is a distinct advance.

The rail mill, which is unique in being almost a continuous mill, is to be driven by motors ranging from 6,000 to 2,000 horsepower capacity, on a 6,600-volt circuit. A few years ago, 220 volts was a maximum pressure for mill service, with all of its dust. At Gary the situation from the standpoint of distribution of current practically compelled the use of high voltage in order to reduce the diameter of the conducting cables, both because of the resulting economy in copper and the improved power factor. While the motors doubtless have been well insulated, the service will be severe and will be watched with much interest.

The present Gary plant, completed or in the process of erection, comprises: A vessel slip and turning basin; ore yards with a capacity of 2,550,000 tons; five unloaders; five ore bridges; ore, coke and stone bins with a capacity for 42 hours of operation for each stack; eight 450-ton furnaces; three primary washers for each two stacks or 12 in all; one cinder tank for each two stacks or four in all; two boiler houses, one containing eight batteries of two Rust boilers each, for furnaces Nos. 9 and 12, the other containing a similar outfit of Stirling boilers for furnaces Nos. 5 to 8; two Zschocke and two Theisen washers to each stack or 16 of each, in all; two blowing engines for each stack and two extra steam blowing engines for furnaces Nos. 9 to 12; two gas holders; one building in which are combined power stations Nos. 2 and 3, containing two 2,000-kilowatt generators with two twin-tandem direct-connected gas engine driving units, for each furnace or 16 in all, and one auxiliary gas-engine generator set and two steam turbines for eight furnaces; a central pumping station; a pig casting plant of six machines; a ladle repair shop; a skull cracker and blast furnace brick storage; four open-hearth buildings Nos. 1, 2, 3 and 4, each containing a battery of 14 60-ton stationary furnaces; a skull cracker between each two buildings; two ingot strippers, Nos. 1 and 2; one refractory brick storage building for each open hearth; an aggregation of 70 10-foot hand-poked gas producers for each open-hearth, or five to a furnace; soaking pits for rail and billet mills, 12 for each mill, each pit accommodating 16 ingots; 24 mechanically poked gas producers for the soaking pits; rail mill and finishing mills with an estimated capacity of 100,000 tons a month; billet mill with an estimated capacity of 100,000 tons a month; a merchant scrap yard for the general handling and preparation of scrap for Gary and other Steel Corporation plants; machine shop; foundry; boiler shop; locomotive house; storehouse; brick shed; clock house and stable.

These various departments will be taken up in detail in the several articles to follow. It may be said with regard to the open-hearth buildings that only Nos. 3 and 4 are nearing completion. The foundations for open hearth No. 1 are in and the fabricators are working on the steel for the building. Work on No. 2 was prevented at the time the other open-hearth foundations were being put in, because the former right of way of the Baltimore & Ohio rail-

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Editor's Note:—The description of the steel plant at Gary is to be presented in a series of articles at short intervals. It is hoped that in so doing the danger of confining too great a quantity of material to one article may be avoided and at the same time the continuity of the descriptions and the proper relationships between the various departments may be preserved. Throughout the entire description, the various installations of equipment will be treated as types of machinery rather than as the products of certain manufacturers, so far as this is feasible. At the conclusion of the description, a complete list will be published in which will appear the manufacturer's name and an identifying description of each installation. To insure accuracy in this matter, memoranda of equipment furnished for the Gary plant are invited.

FIG. 1—BROADWAY AVE., GARY, AS IT IS AT PRESENT.

road passed directly over the site, and had not yet been abandoned. This building will be a part, however, of the plant as contemplated for immediate completion. The ingot strippers, now to be used for open-hearths Nos. 3 and 4 are strippers Nos. 1 and 2, the erection of Nos. 3 and 4 being held up for the further filling in of the shore lines.

The further construction already authorized includes eight additional blast furnaces with ore-handling equipment, gas washers, blowing engines, power plants and other auxiliary installations to be increased in the same relations as exist in the completed plant. Five new pig cast-

FIG. 2—BROADWAY AVE., GARY, ON JULY 21, 1906.

Amount of work accomplished entirely outside of the steel plant is illustrated in part by the contrast with the same view in Fig. 1, taken 27 months later.

ing machines will be added instead of six and instead of combining power houses Nos. 1 and 4, No. 4 will be located at the north end opposite furnaces Nos. 13 to 16, to be built on filled ground, and No. 1 will be located at the south end opposite furnaces Nos. 1 to 4. Two additional open-hearths will be built together with a 48-inch universal plate mill, a 160-inch sheared plate mill, five merchant mills from 18 inches down to 8 inches, and an axle mill. A structural mill is a future possibility.

In addition to the task of preparing the steel plant site and erecting this immense group of buildings, scribed at other times, notably in THE IRON TRADE REVIEW of Nov. 21, 1907.

The tract of land is located on or adjacent to five railway trunk lines. The main lines of the Baltimore & Ohio railroad and the Indiana Harbor railroad ran directly through the mill site. It became necessary at once to enter into an agreement with these railroads whereby their lines were changed so as to run south of the mill site. This change also involved a change in the main line of the Lake Shore & Michigan Southern railway for a distance of several miles. A great deal of clearing, was provided entirely from the surplus net profits of the Steel Corporation. It was expected that approximately $18,000,000 could be expended in 1908 which would make a total outlay to date of about $42,000,000. The first appropriation for Gary was made in 1905, amounting to $10,000,000. To this was added $21,500,000 in 1906 and $18,500,000 in 1907, making a total of $50,000,000, of which some $8,000,000 still remains unexpended according to the estimate. The work authorized calls for the expenditure of about $9,500,000 more than has been appropriated thus far but with $8,000,000 still to dispose of,

FIG. 3—DIGGING A NEW CHANNEL FOR THE CALUMET RIVER IN JULY, 1906.

The diverting of this river was one of the first steps in preparing the plant site. The old channel cut across the site of the office building and into swamp land at the southeast end of the plant, in which the slip and turning basin have been excavated.

all of which has been accomplished in the comparatively brief period since August, 1906, the Steel Corporation, through its subsidiaries, the Indiana Steel Co., the Gary Land Co. and the Chicago, Lake Shore & Eastern railway, undertook the supervision and in part the actual building of the town of Gary, and a great deal of terminal railroad work. The entire property purchased by the Steel Corporation is a tract of land of about 9,000 acres, with approximately ten miles of frontage on the southern end of Lake Michigan at a distance of 25 miles from Chicago. The tract will be materially increased by the filling in of the shore line property. The building of the town of Gary has been completely degrading and filling was done in connection with this work for which an adjustment of expenditures is to be made between all the companies interested. West of the plant, the C., L. S. & E. railroad has built an immense yard known as the Kirk yards in which are 50.51 miles of a standard gage track. Within the plant 75.14 miles of track has been laid and additional grading has been completed for future tracks.

The financing of this undertaking is quite comparable with the extent of the engineering problems in its magnitude. The total expenditure required to complete the work has been estimated at $75,000,000. The amount expended at the end of December, 1907, was $24,063,388.53. This amount the official pocket-book is far from flat. It is a matter of record that of the $28,000,000 available on Jan. 1, 1908, about $19,000,000 was invested in marketable securities while $7,000,000 was in cash or immediate assets of the Steel Corporation. The freedom permitted by this unhampered financial provision for the building of Gary was amply shown during the past year when erection work proceeded without interruption.

With all the boldness and far-sightedness of the project, reasonable assurance was required that there should be demand sufficient to absorb the productive capacity planned. It will be some time before the Gary open-hearths can produce much more than 1,250,000 tons of ingots a year, nor

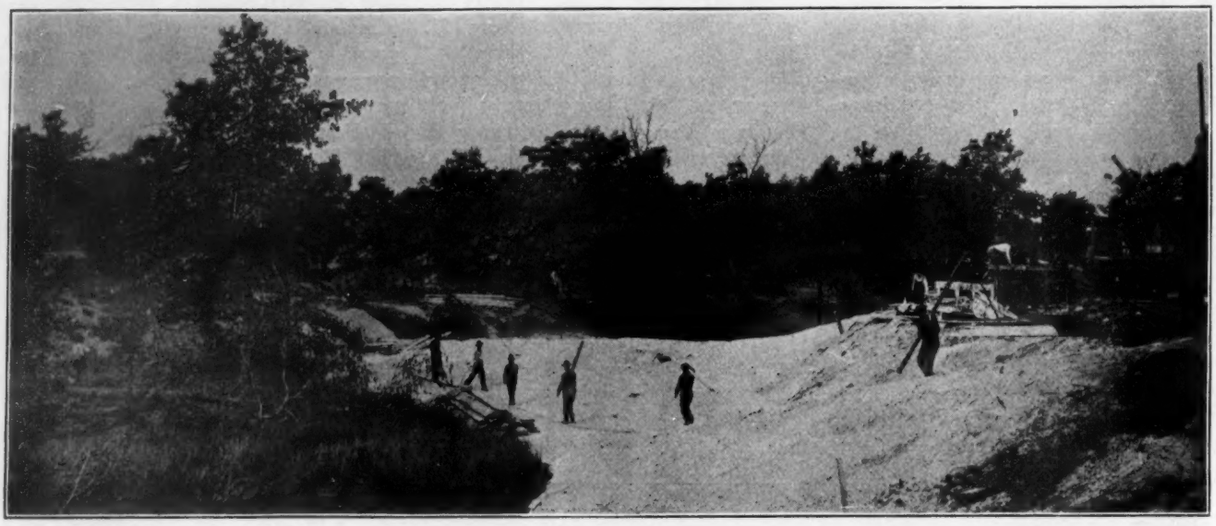


FIG. 4—SITE OF THE STOREHOUSES AND SHOPS AT THE ENTRANCE OF THE PLANT; TAKEN AUG. 3, 1906.

will anything like 1,000,000 tons of rails be rolled this year. The foundations for the billet mill have just been completed and at least the present year will pass before this mill is rolling on full schedule. It is maintained with regard to the units already complete and those to come, that as great a proportion of operation, at the rate of most economical production, will be attained at Gary throughout each year of operation, as at any of the present manufacturing plants. To make the western market independent of the eastern mills is the function of Gary. The gradual accomplishment of this purpose will directly affect that large tonnage of rails, billets, plates and bars that is now diverted from the west to the American Steel & Wire Co. and the Carnegie Steel Co., in the east.

There is in reality little occasion for anticipating a severe disturbance of existing market conditions in the Chicago territory because of this new capacity. The Gary plant represents an adjustment of production within the Steel Corporation rather than new capacity seeking tonnage in the west. Rather will the eastern capacity which Gary displaces, require to be provided for, than otherwise.

Attention has been directed to the large tonnage of scrap that will be consumed at the Gary open-hearth furnaces. Without forcing the situation in any respect, the percentage of scrap employed in the open-hearth charging may be brought down as low as 25 per cent of the total. With a production of 800,000 tons of ingots during 1909, which at this time seems to be a fair prediction, only 200,000 tons of scrap will be absolutely required. This much the Chicago dealers accumulated with ease during the past year. To this may be added fully 160,000 tons of steel scrap—rail scrap ends and ingot discards—which may be expected from the Gary plant itself. This material is of course not the best kind of steel and under ordinary circumstances purchased material of various grades will be mixed with it. When it is remembered, however, that there is to be a scrap yard at Gary where

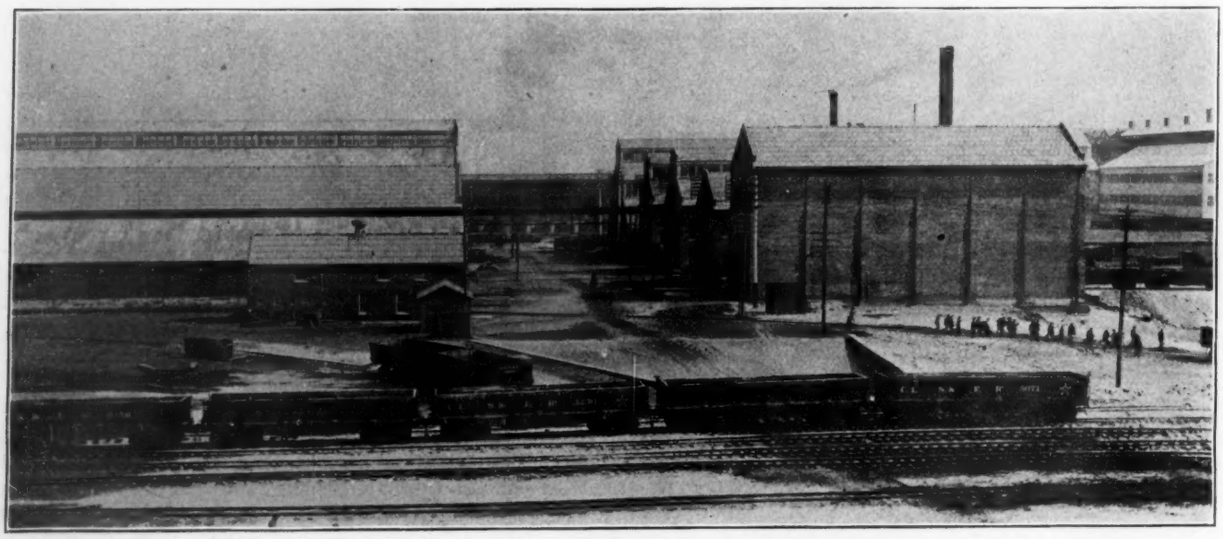


FIG. 5—ENTRANCE TO THE STEEL PLANT BETWEEN THE SHOPS.

A time clock house has since been erected in front of the pattern storage building on the right. The tracks in the foreground are the C. L. S. & E. under which a subway has been built. This is in contrast to Fig. 4, which is a view of the same location Aug. 3, 1906.

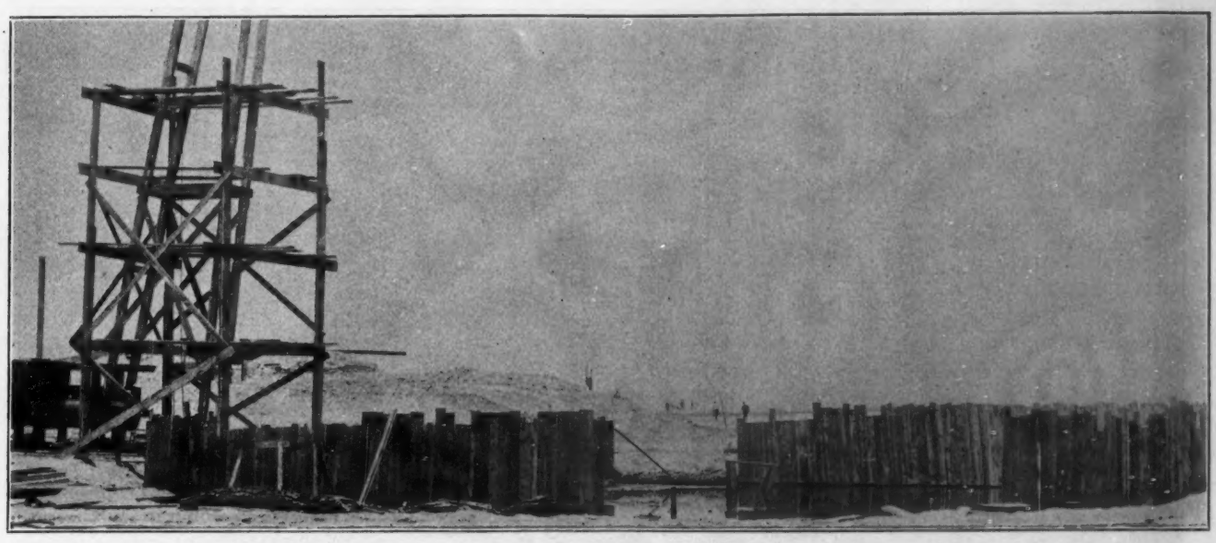


FIG. 6—SITE OF FURNACE NO. 12.

At the time construction was begun this location was only a few feet from the shore line. Since then the shore line has been built out 1,000 feet, and the lake will be filled far enough out to permit of building furnaces Nos. 13, 14, 15 and 16 on made ground, and in addition connecting the railroad loop which will extend entirely around the plant.

material, picked up in any quarter and in any condition, may be handled, it is apparent that little disturbance of the market will result from the buying of such tonnage as is required.

The laying out of the steel works presented itself as a railroad switching problem and a glance at the insert showing the ground plan will make it clear wherein the Gary steel plant is one of the most remarkable railroad yards in the world. This plan is not quite complete and does not show how the railroad loop is to be connected along the north end of the site where the shore line property is not yet filled. When this is completed, there will be a continuous connection entirely around the plant for a length of approximately eight miles. It will be possible then to have continuous travel in one direction to and from any part of the plant. All of these tracks are standard gage. The matter of laying out the blast furnace plant, open-hearths, power plants and other departments was interwoven with the solution of the railroad problem. A general scheme was evolved in which the entire plant was divided into four units with four blast furnaces and their auxiliaries as the basis for each unit. These units extend in parallel lines from the slip on the east to the finishing mills on the west. The present construction is concerned with the building of the two middle units from furnaces No. 5 to No. 12. Units No. 1 and No. 4 remain to be built on the south and north sides of the site, respectively, and will include furnaces Nos. 1 to 4 and furnaces Nos. 13 to 16. The connecting railroad spurs from one side of the loop to the other, which comprise the service tracks running through and paralleling the furnaces and various buildings, have a general north and south direction while between each

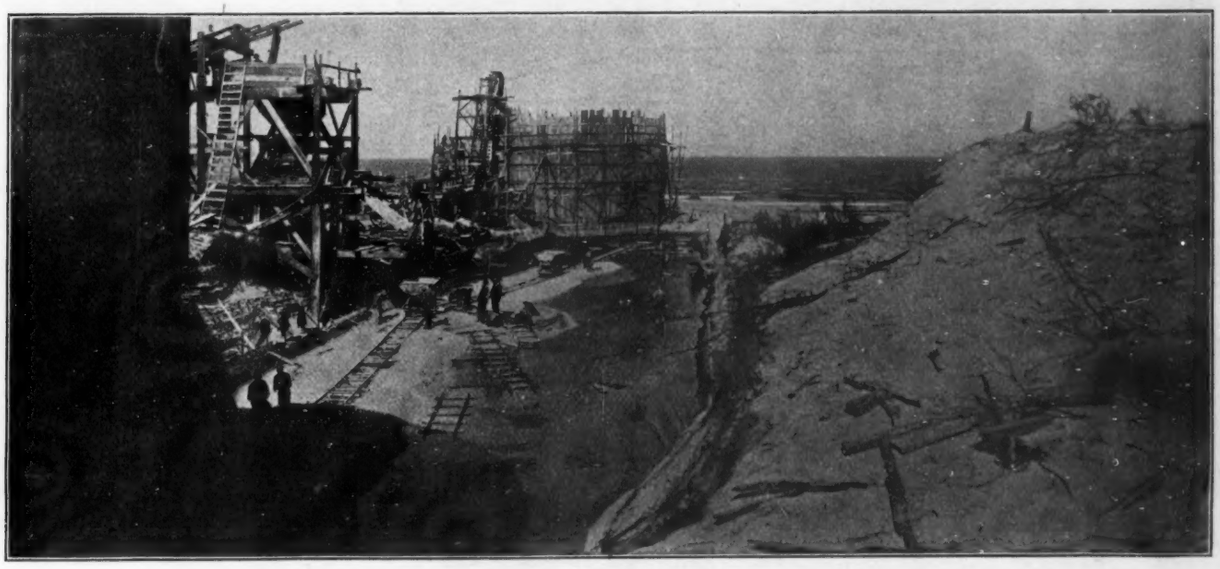


FIG. 7—PROGRESS OF THE WORK ON FURNACE NO. 12, THREE MONTHS LATER.

The concrete work is in progress on the stove foundations also.

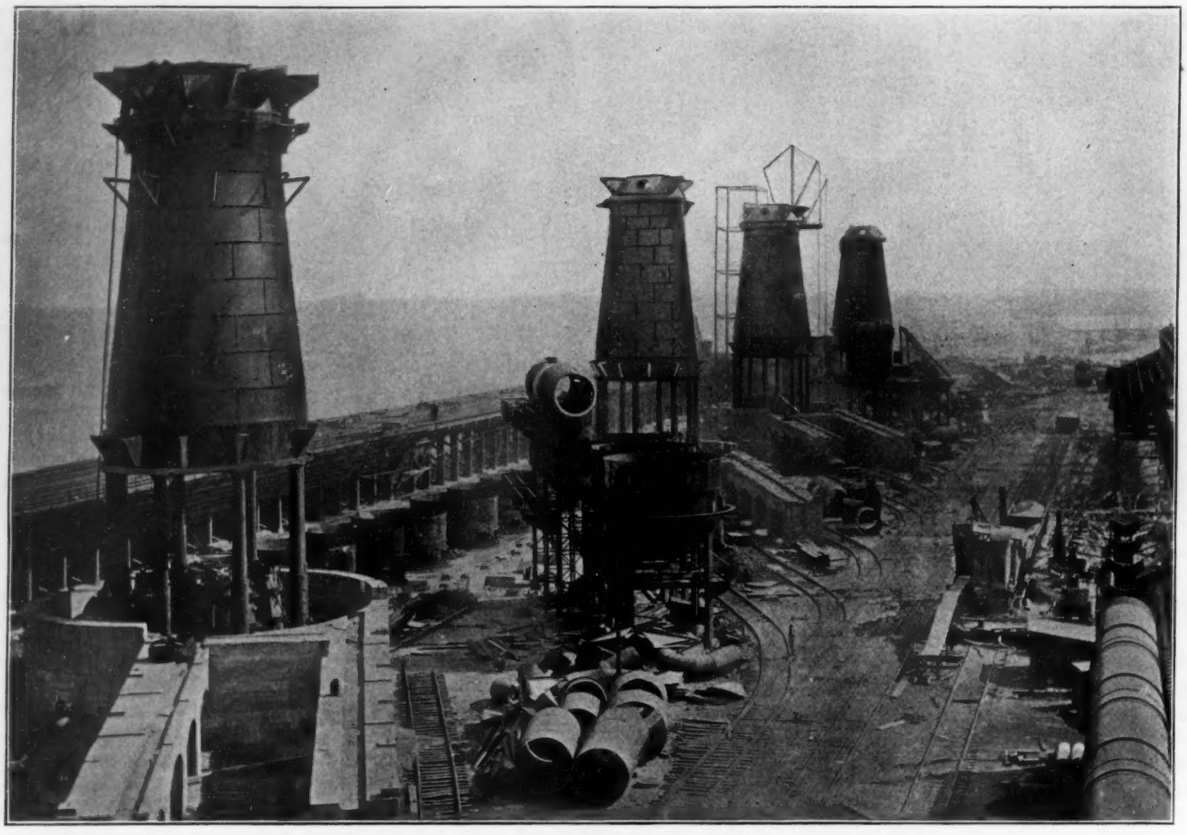


FIG. 8—BIRD'S EYE VIEW OF FURNACES NOS. 5, 6, 7, 8.

This is an excellent general view of the scheme of the entire blast furnace lay-out. The relations of the ore bins, stoves, furnaces, cast houses, primary washers and trackage is clearly shown. The more distant washers serve stacks Nos. 5 and 6. The others, stacks Nos. 7 and 8. Between furnaces Nos. 6 and 7 will be located the concrete tank for granulating cinder from these two stacks. Similarly between the rest of the furnaces alternating with the washers there will be granulating tanks. Ordinarily the spur running between the cast house piers will be the hot metal track. The spur on the near side is an auxiliary hot metal track and the spur on the far side is for slag. All of the stacks will have a cinder notch on the side of this track but in addition the even number stacks, as No. 6, will have two cinder notches diametrically opposed, so that the slag may be conveniently run to the granulating tank when desired. The arching of the concrete piers not only saves material but provides a free runout for the iron in case of trouble. The gap between the piers is spanned with rails laid head down on the concrete and covered with removable cast iron plates for the cast house floor. The easy curves into each cast house and the economy of space as the result of setting the cast houses at an angle makes this the best blast furnace arrangement in the world. The main hot metal track will run in a straight line, 105 feet from the center line of the furnaces, from the loop at the north end to the pig casting plant at the opposite end, a distance of nearly a mile. At every four furnaces there will be a complete set of cross-overs to the open hearths.

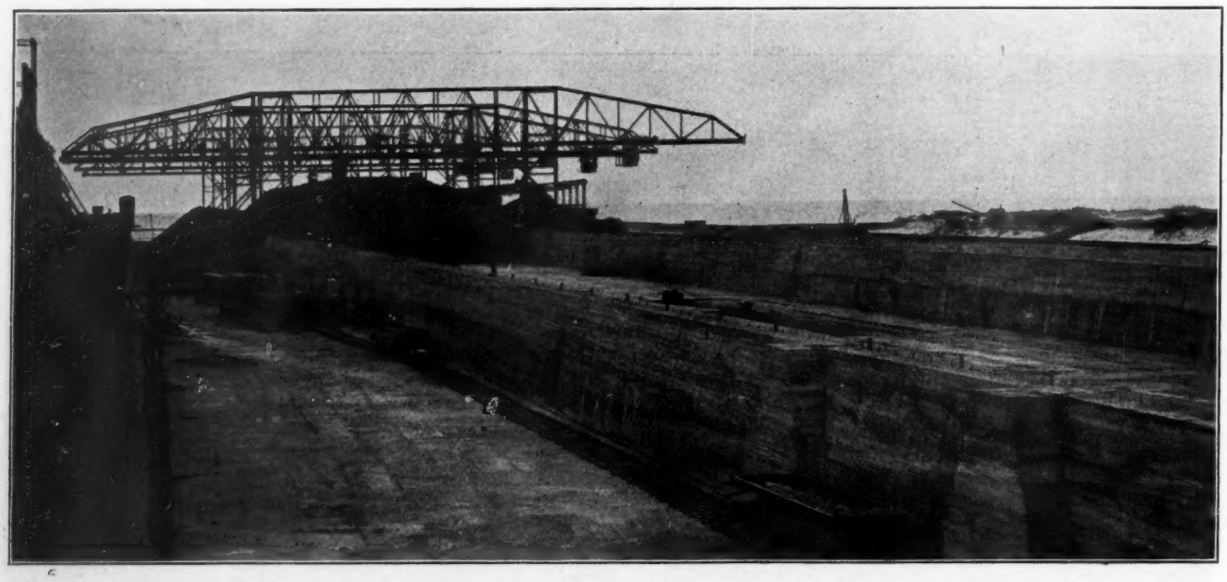


FIG. 9—ORE YARDS LOOKING NORTH.

A little over 750,000 tons of ore had been brought to Gary at this time, Nov. 10, 1908. The bins are completed for a length of approximately 2,100 feet from stack No. 5 to No. 12. The total maximum capacity of the yards is 1,214 tons per lineal foot, based on a weight of 140 pounds per cubic foot for ore. There is capacity at present, therefore, for 2,550,000 tons or half of the finished capacity. Mesabi range ores are stored in the large yard on the right and old range ores which are used in lesser quantity in the smaller yard. The concrete bottom is 18 inches thick laid on the sand and the walls are 8 feet thick and contain about 7½ cubic yards of concrete per lineal foot. The walls on which the unloaders and bridges are carried are heavier and contain about 60,000 yards of concrete.

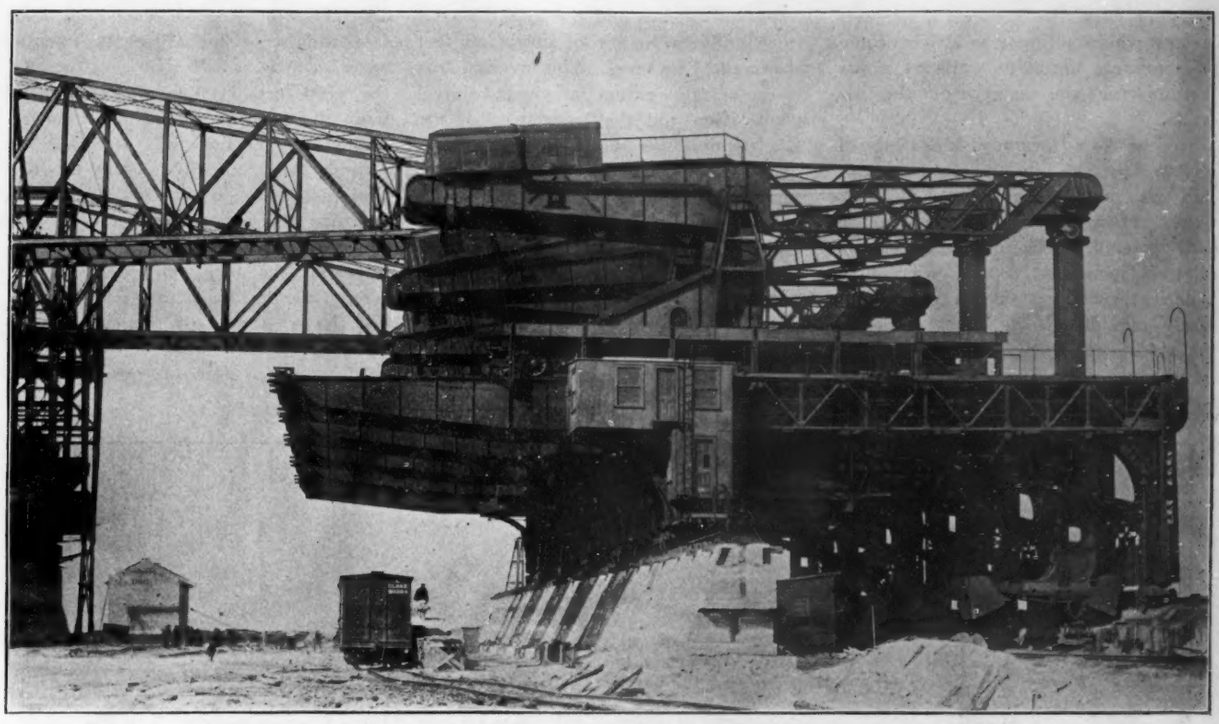


FIG. 10—IMPROVED HULETT ORE UNLOADERS.

Five of these are installed, of the same type as those at the Lorain plant of the National Tube Co. They have a capacity of 250 tons per hour. The ore trough wall, the construction of which is shown in Fig. 11, had not been built at the time this photograph was made. The freight car is shown in what is now the ore trough. The unloader grab is lowered over what will be four tracks for shipping ore from Gary to other plants—Joliet in particular. The conduits for the electric cables are also shown carried in the concrete.

pair of units is a complete set of crossover tracks which provide for the generally east and west movement of the materials in process of manufacture from ore to steel.

The essential characteristic of the plant is uniformity gained through duplication, with an extremely simple arrangement as a result. There are certain unique conditions not ordinarily attendant upon steel mill construction heretofore, which contributed to this end. There was but one kind of steel to be made. The entire project was before the engineers, to plan completely before a building was located. There was here no designing by piecemeal. The plan adopted provides for the production of a larger tonnage of steel per acre of ground that at any other plant in the world. The entire steel plant site embraces abou 1,000 acres, that portion of it in which the steel ingots will be made, from ore yard to ingot stripper, about 300 acres. With the completed plant capable of producing 4,050,000 tons of ingots annually, a ratio of 13,500 tons of ingots per acre of ground per annum will be attained. The striking feature of the scheme by which this condensed arrangement was obtained without impairing the freedom of transportation is found in the placing of the furnace cast houses and open-hearth buildings at an angle to the north and south lines. In effect, this permitted short, easy curves, instead of wide-swinging 90-degree layouts.

To prepare the plant site was a matter of magnitude rather than of great difficulty. The property when acquired was a stretch of alternate dunes and hollows, the upper stratum of soil being a layer of fine, clean lake sand from 30 to 60 feet deep. The surface had an average height of about 20 feet above the water level in the lake and rose toward the south with a slope of approximately 2 inches to 100 feet. Below the upper sand at a depth of about 30 feet below the water level, is a solid stratum of hard clay. Although it was frequently necessary to go below water level, the soil conditions were very well adapted to the building of large foundations for heavy loads. In this continuous heavy bed of sand, it was not necessary to go deep to bottom the footings or foundations and no special provisions were required for

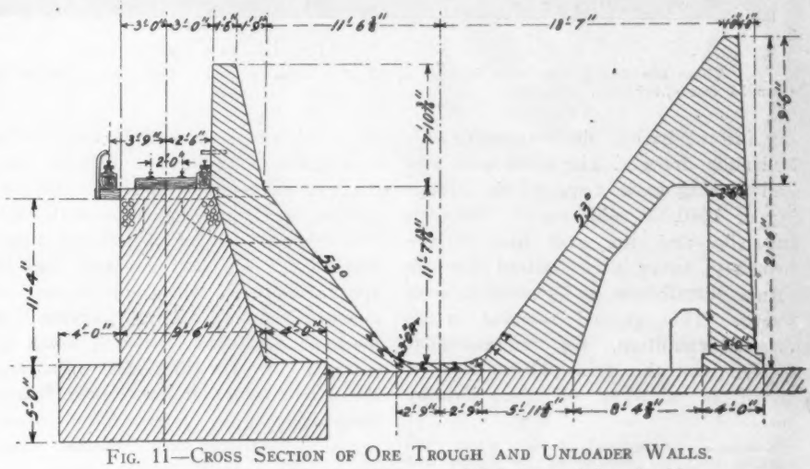


FIG. 11—CROSS SECTION OF ORE TROUGH AND UNLOADER WALLS.

The trough is V-shaped with a rounded bottom reinforced with 75-pound rails. The trough has a capacity of 35 tons per lineal foot.

carrying even the heaviest structures, except where piling was driven under the concrete unloader walls as a precaution for the safety of the slip walls.

In the low swampy lands at the east end of the site the Calumet river had its mouth, its course to there being through the south end of the mill ground. The diverting of this channel for about a mile was undertaken at once, so that it is now entirely outside of the plant enclosure. At a low point leading from the lake southward into the swamps, dredging for the harbor slip[1] was begun with hydraulic dredges. The completed slip and turning basin required the dredging of 1,500,000 cubic yards. Between the slip and the east line of the property, space was allotted for the future installation of by-product coke ovens. This ground remains in its original condition. On the remainder of the site the principal work consisted of clearing off the scrubby trees and bushes and leveling the land to a uniform height of about 20 feet above the lake level. The leveling was to a certain extent a steam shovel proposition and the large area of the site required the movement of a large quantity of material. The filling in of the lake property and grading with cinder brought from Joliet were carried on simultaneously. Most of the leveling preceded construction work, but some of the larger building sites were excavated at the time. Although a number of the foundations extend below water level, there was no need of deep foundations. The foundations constitute a distinct feature in themselves and will be described briefly in connection with each department. All of the heavy foundations are of mass concrete and in connection with the great amount of concrete required and the construction methods employed, there is much of interest. In the unloader walls and the foundations for the power house, blowing engine house, and open-hearths, approximately 350,000 cubic yards of concrete were placed.

The completed harbor slip will be 250 feet wide, 25 feet deep and 5,000 feet long, not including the turning basin, which is 750 feet across. Of the 5,000 feet, 3,000 feet extend inland from the original shore line. The remaining 2,000 feet was dredged out into the lake, at which point the natural depth is about 25 feet. This distance represents the width of submerged property which is to be filled in along the lake side. About 1,000 feet of ground has already been made. On the west side of the slip, a massive concrete wall containing 6 cubic yards of concrete per lineal foot extends for the entire length and entirely around the turning basin. Mooring posts are located conveniently and the longest boats once in the slip can be warped to any point and out again without the assistance of a tug. To be provided with a turning basin is unusual among steel plant shipping facilities. The lake course to Gary is a straight run for the harbor.

From the face of the dock wall to the center line of the furnaces is 609 feet 3 inches. This width for a length of 4,000 feet will be occupied by the

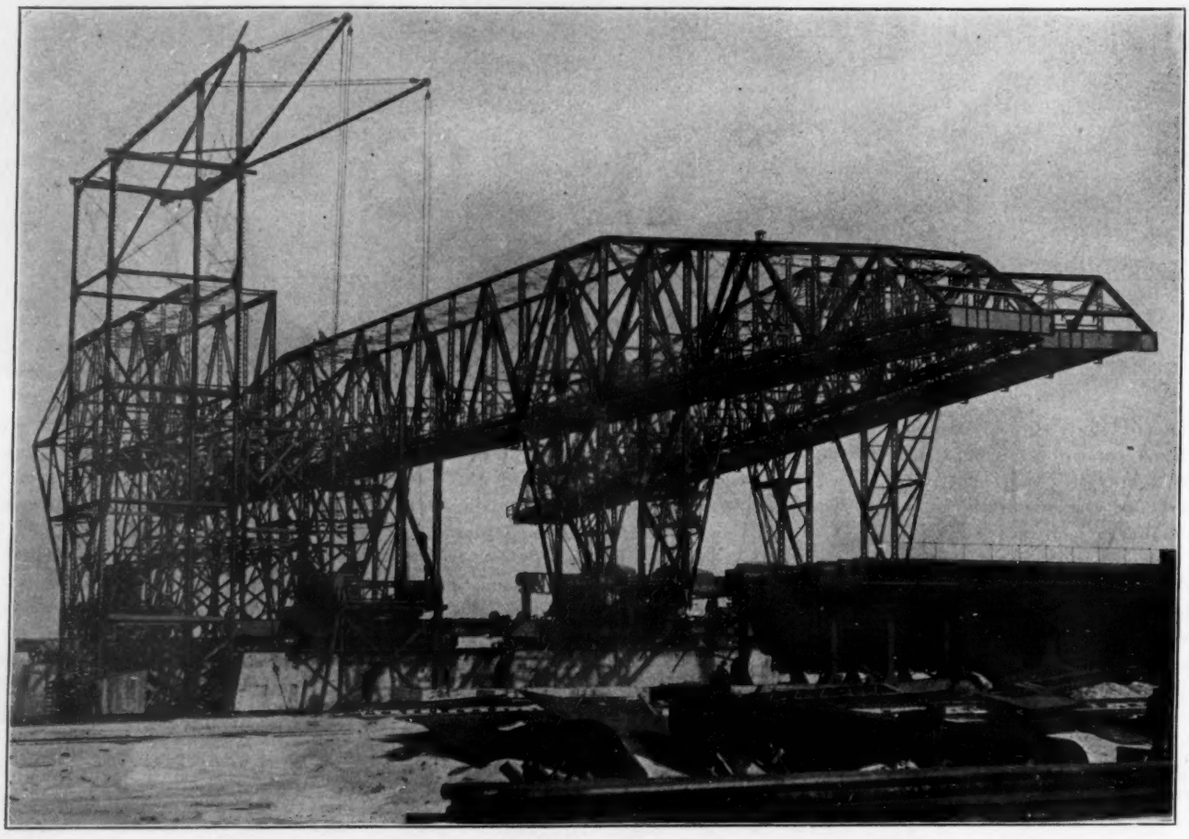
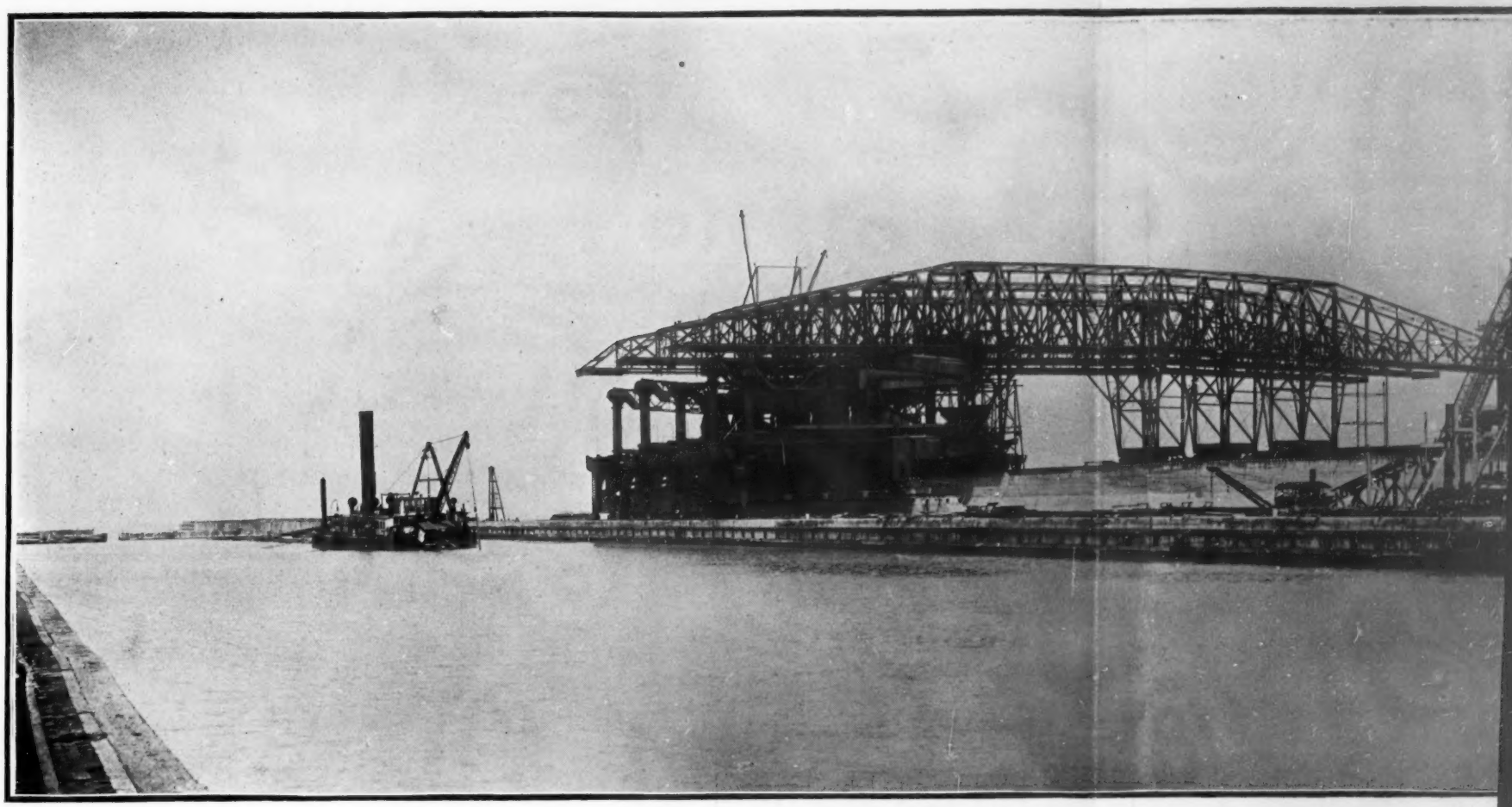


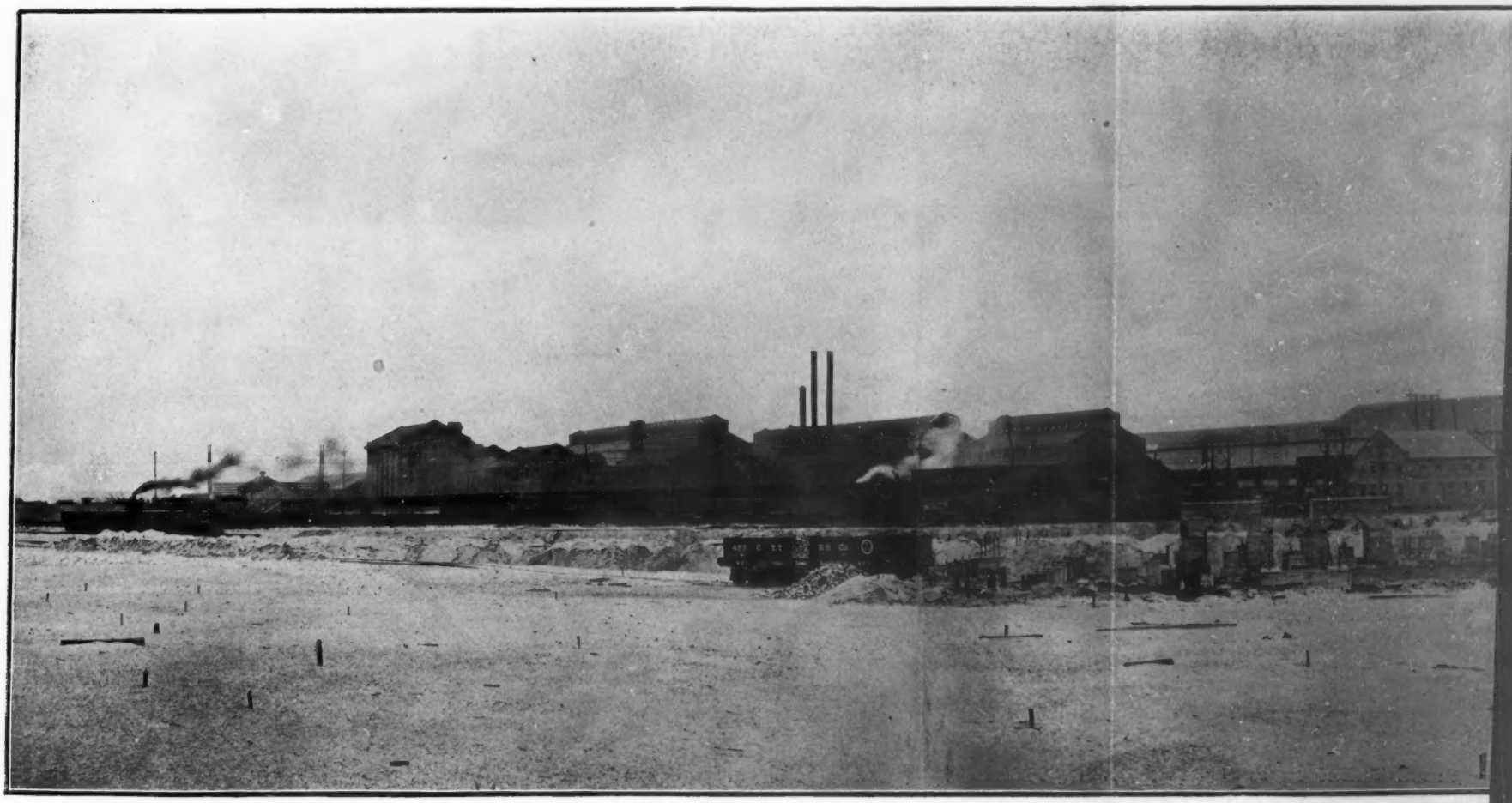
FIG. 12—THE ORE BRIDGES.

There are five bridges with buckets of 15 tons capacity each. The distinct feature of these bridges, namely the provision for skewing them 75 feet either way, is shown.

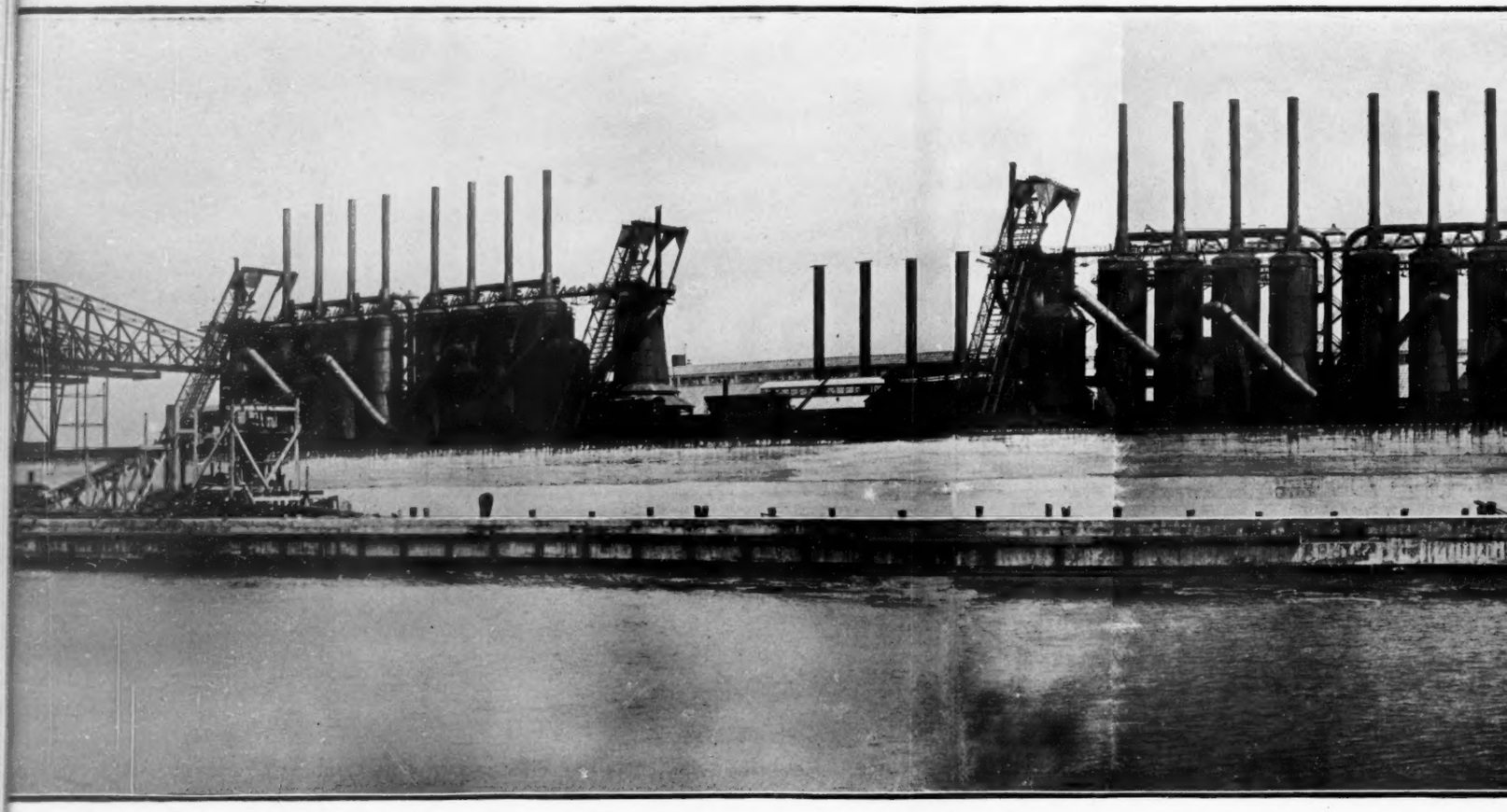
[1]Complete descriptions of the plants and methods used in constructing the harbor and in handling the concrete foundations may be found in the *Engineering Record* of Aug. 17, 1907, and Nov. 2, 1907.



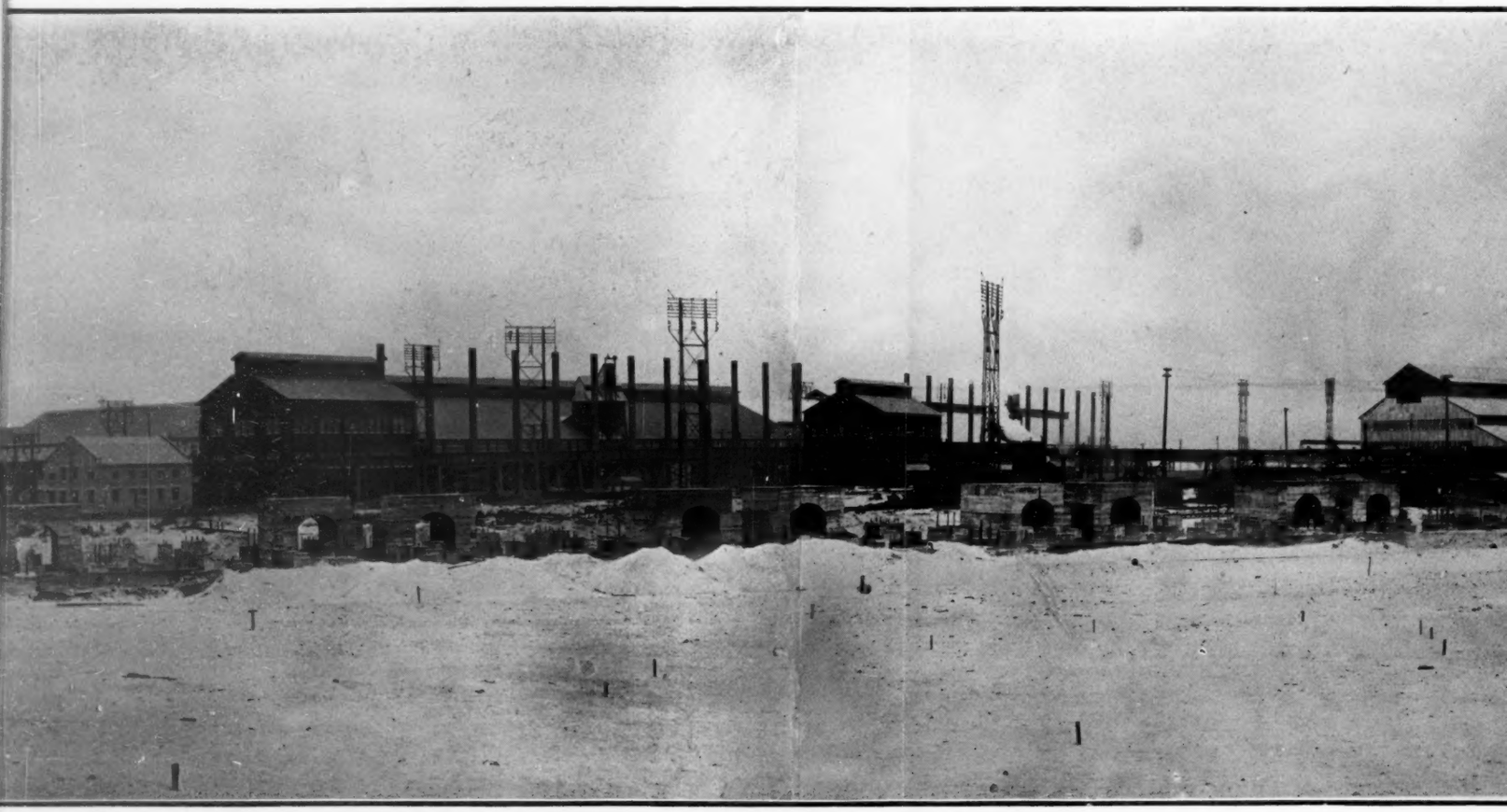
Panoramic view of the four completed furnaces Nos. 9, 10, 11 and 12, prior to the erection of stacks
points, as they will be between every four furnaces. The concrete ore yards are now completed to a point lo
necessary place is also shown here.



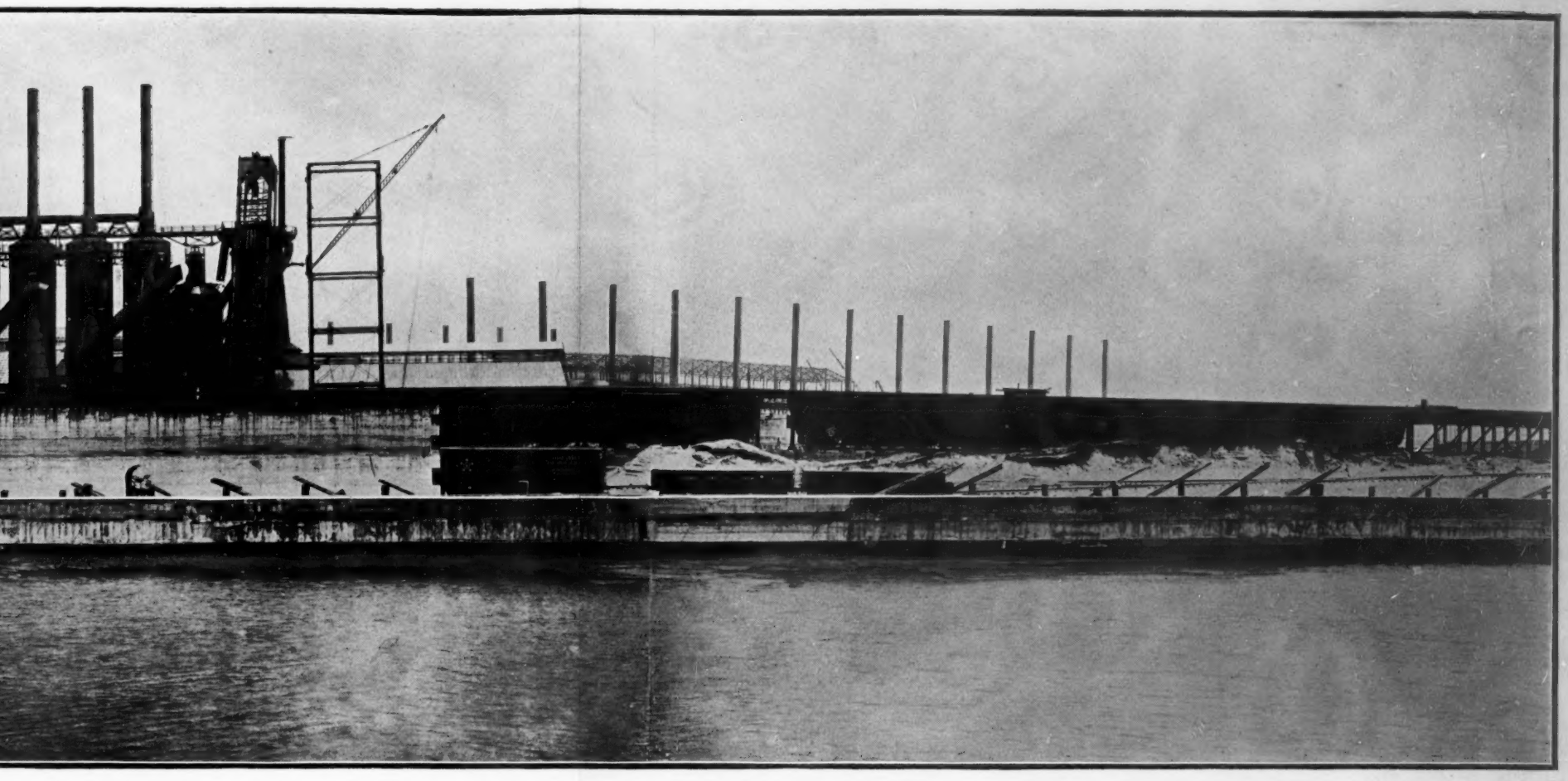
Panoramic view of Gary plant. This is taken from South Railroad yard. It is complete except for
machine shop and foundry. The steel trestle shown divides, one branch going to the soaking pits and the c
Behind the strippers are soaking pits for rail and billet mills. The roof of the rail finishing mill appears in
incompleted furnaces shown at the extreme right are stacks Nos. 5, 6 and 7.



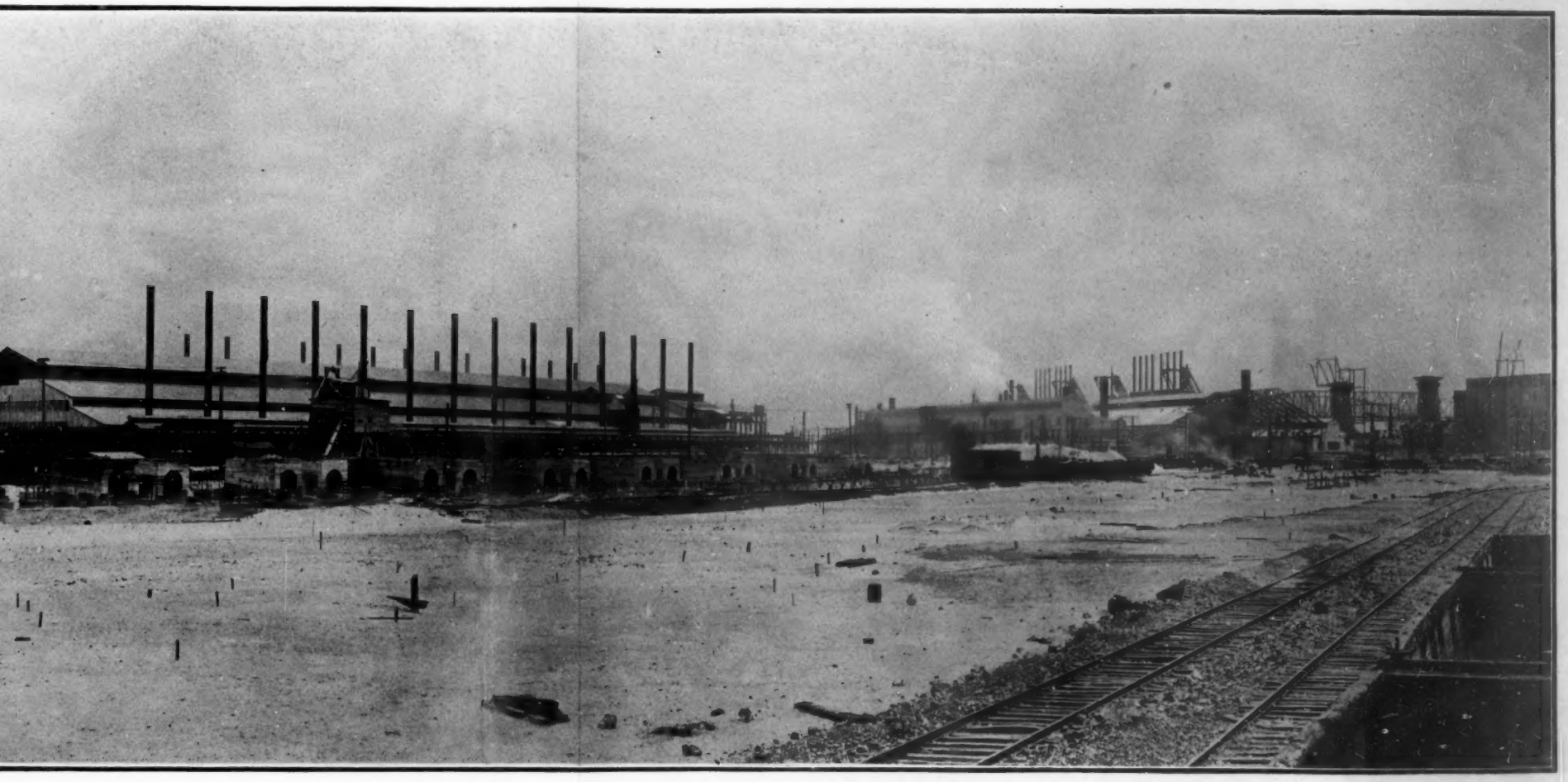
to the erection of stacks Nos. 5, 6, 7 and 8. At the extreme left it will be noticed that there is a break in the ore bins and only a trestle supports the tracks. There are no bins here betw
ow completed to a point located relatively to furnace No. 5 as the end of the yards are to furnace No. 9 in this view. The arrangement of the two dust catchers is clearly shown in this v



is complete except for the cutting out of the office building on the left end and the pig casting plant on the right end. Looking from left to right there can be seen the various shops—patter
e soaking pits and the other to open-hearth No. 3. The foundations in the immediate foreground are for open-hearth building No. 1. Directly behind the trestle the two high, short structures a
finishing mill appears immediately at the left of No. 1 stripper. Continuing toward the right is open-hearth No. 3, and back of it the stacks of open-hearth No. 4. Following comes the electric



oins here between furnaces Nos. 6 and 7, nor between Nos. 10 and 11, because the switching crossovers are located at these own in this view. The strikingly unusual extent to which stairways, platforms and guard railings have been carried to every



shops—pattern storage, pattern shop, electric repair shop, blacksmith shop, boiler shop—and beyond them the roofs of the rt structures are ingot strippers Nos. 1 and 2. Strippers Nos. 3 and 4 will follow, to be built to the right of Nos. 1 and 2. es the electrical generating plant, the blowing engine house, Stirling boiler house, blast furnaces, ore yards and slip. The

SHORE

NORTH CAR STORAGE YARD

FENCE

N

160" SHEER PLATE MILL

STRIPPER BUILDING

GAS PRODUCER

48" UNIVERSAL PLATE

SLAB YARD

CRANE RUNWAY

MOTOR HOUSE

BILLET MILL

MOTOR HOUSE

SOAKING PITS

8" MERCHANT MILL

10" MERCHANT MILL

12" MERCHANT MILL

14" MERCHANT MILL

18" MERCHANT MILL

WAREHOUSE

WAREHOUSE

WAREHOUSE

C.L.S. & E. ROUND HOUSE

AXLE MILL

MOTOR HOUSE

RAIL MILL

HOT MILL

FINISHING DEPT

ROLL SHOP

MACHINE SHOP

BOILER SHOP

BLACKSMITH SHOP

FOUNDRY

HOSE REEL

ELECTRIC REPAIR SHOP

ENGINE HOUSE

STORE HOUSE

PATTERN SHOP

BRICK SHED

PATTERN STORAGE

STABLE

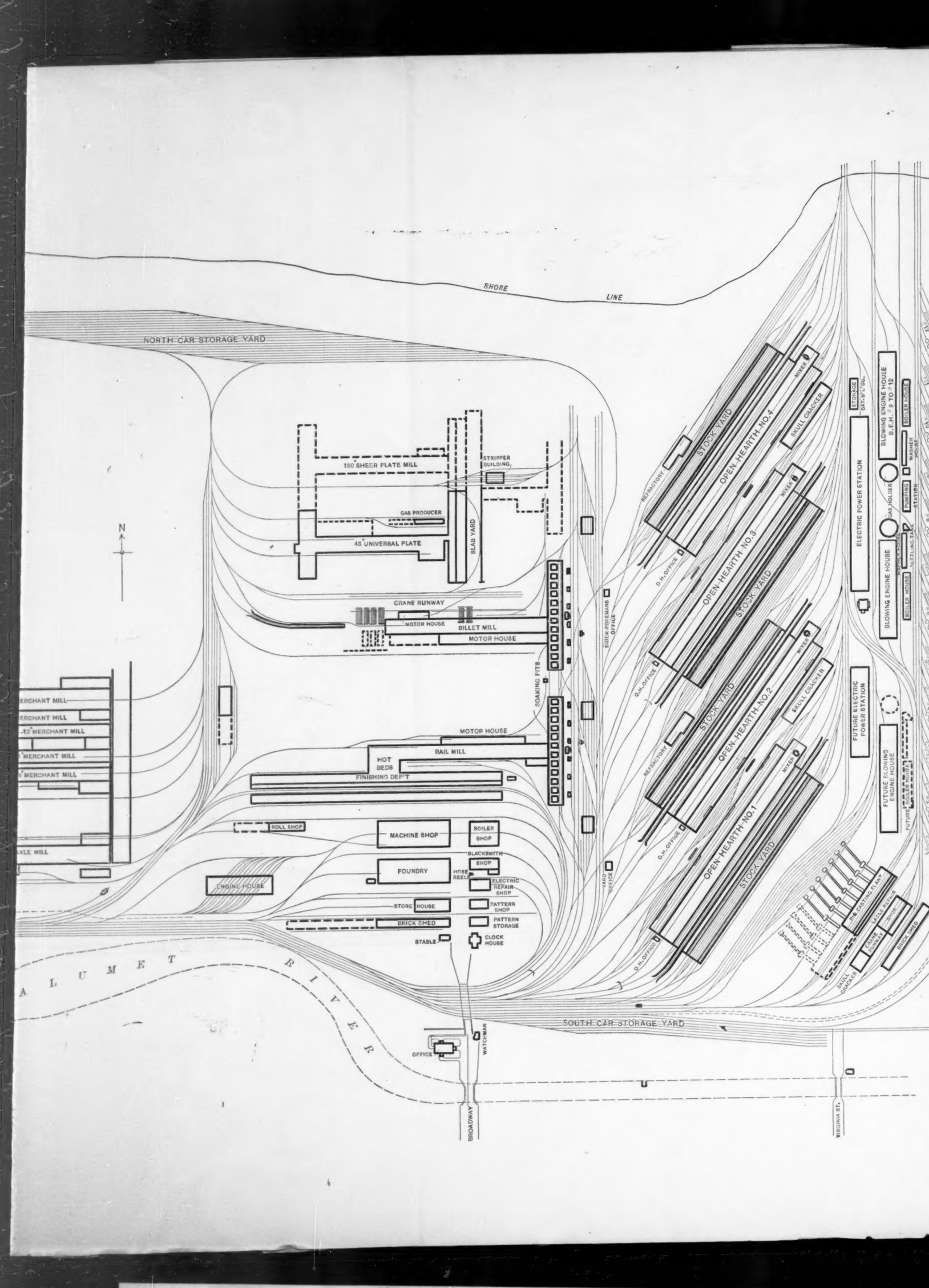
CLOCK HOUSE

C A L U M E T R I V E R

OFFICE

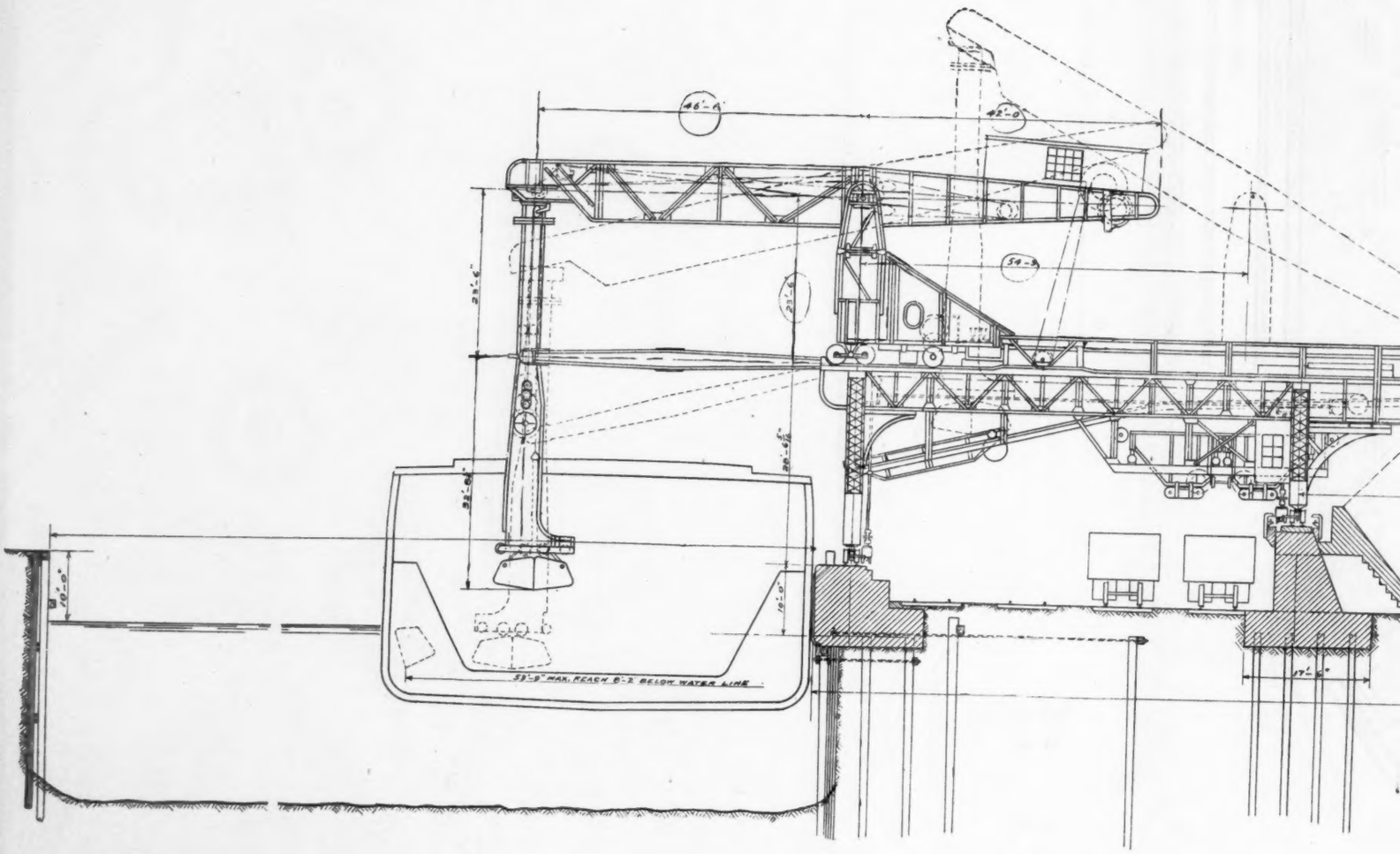
WATCHMAN

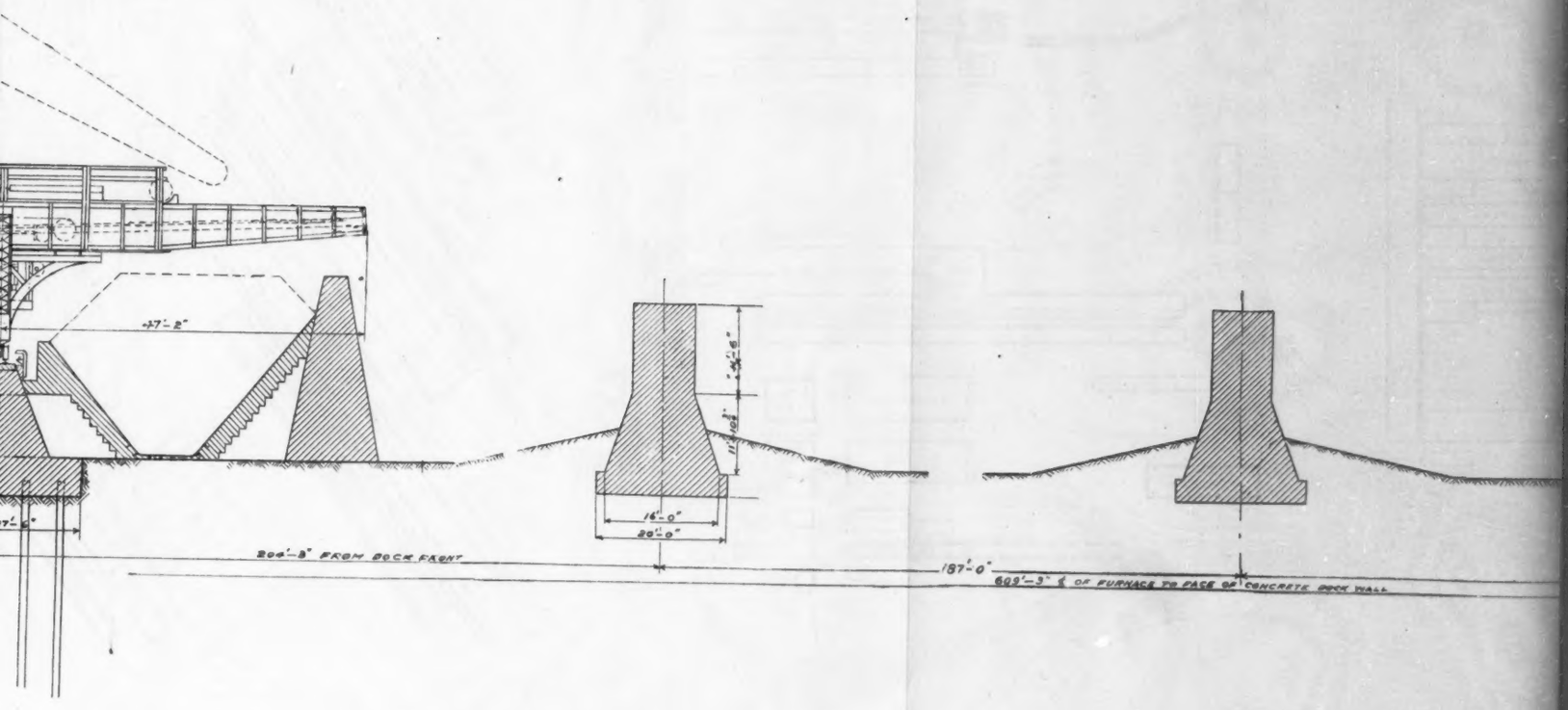
BROADWAY

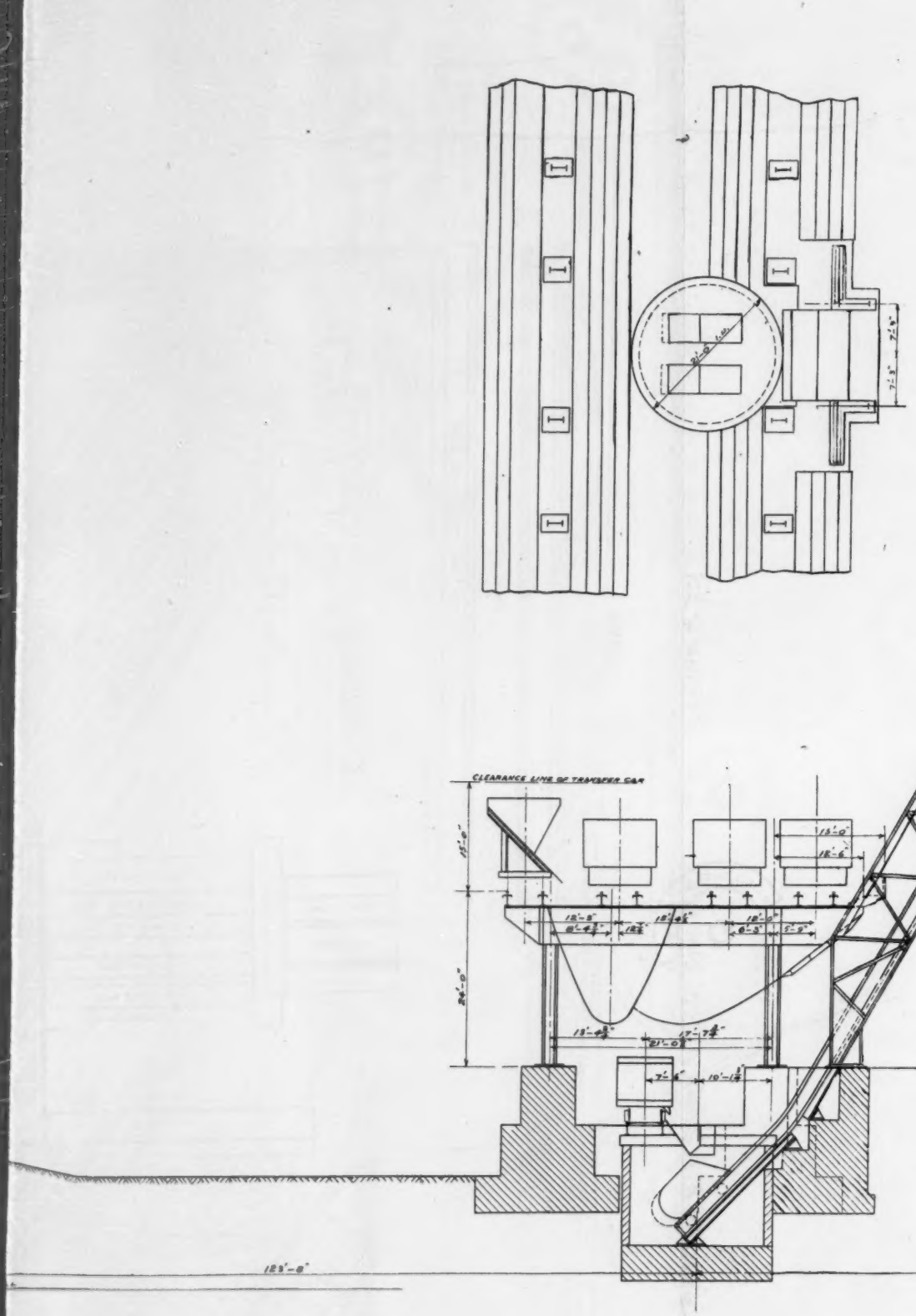

SHORE LINE
NORTH CAR STORAGE YARD
160" SHEER PLATE MILL
STRIPPER BUILDING
GAS PRODUCER
48" UNIVERSAL PLATE
SLAB YARD
N
CRANE RUNWAY
MOTOR HOUSE
BILLET MILL
MOTOR HOUSE
SOAKING PITS
BRICK FOREMANS OFFICE
MOTOR HOUSE
RAIL MILL
HOT BEDS
FINISHING DEPT
ROLL SHOP
MACHINE SHOP
BOILER SHOP
BLACKSMITH SHOP
FOUNDRY
HOSE REEL
ELECTRIC REPAIR SHOP
ENGINE HOUSE
STORE HOUSE
PATTERN SHOP
BRICK SHED
PATTERN STORAGE
STABLE
CLOCK HOUSE
YARD OFFICE
STOCK YARD
OPEN HEARTH NO.4
SKULL CRACKER
MIXER
REFRACTORY
O.H. OFFICE
STOCK YARD
OPEN HEARTH NO.3
MIXER
STOCK YARD
OPEN HEARTH NO.2
SKULL CRACKER
MIXER
REFRACTORY
O.H. OFFICE
STOCK YARD
OPEN HEARTH NO.1
MIXER
O.H. OFFICE
STORAGE GAS HOLDER
ELECTRIC POWER STATION
BLOWING ENGINE HOUSE B.E.H. #9 TO #12
BOILER HOUSE
HAMMER HOUSE
PUMPING STATION
GAS HOLDER
PUMPING STATION
SETTLING TANK
BOILER HOUSE
BLOWING ENGINE HOUSE
FUTURE ELECTRIC POWER STATION
FUTURE BLOWING ENGINE HOUSE
FUTURE BOILER HOUSE
#8 CASTING PLANT
LADLE REPAIR SHOP
CRANE RUNWAY
BRICK SHED
SKULL CRACKER
SOUTH CAR STORAGE YARD
OFFICE
WATCHMAN
BROADWAY
VIRGINIA ST.
CALUMET RIVER

General Ground Plan and Track Layout for the Plant of the Indiana Steel Co., at Gary, Ind. The Pig Casting Plant is Shown in the Southeast Corner.

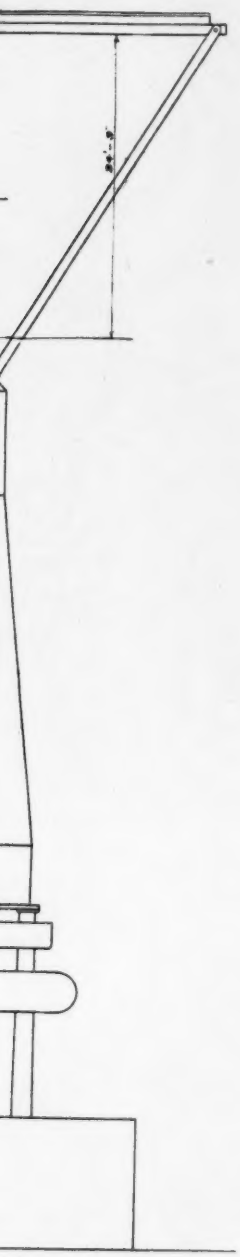
(Over)


46'-0"
52'-0"
54'-9"
23'-6"
23'-6"
24'-6½"
32'-0"
10'-0"
10'-0"
53'-9" MAX. REACH 8'-2 BELOW WATER LINE
17'-6"


+27'-2"
16'-0"
20'-0"
200'-8" FROM DOCK FRONT
187'-0"
609'-3" ℄ OF FURNACE TO FACE OF CONCRETE DOCK WALL



Cross Section T
Ore Unloaders, C
Ore Yard, Ore,
Coke Bins, and Bla
at Gary Plant of
Steel Co.



Section Through Slip,
nloaders, Ore Trough,
ard, Ore, Stone and
ins, and Blast Furnaces,
Plant of the Indiana
o. (Over)

FIG. 13—ORE BIN FRAMEWORK AND FOUNDATIONS.

Both the steel and the concrete are very heavy. With four tracks, all standard gage and spaced 6 feet 6 inches, the track loads will be the heaviest ever attempted.

FIG. 14—VIEW ALONG THE TOP OF THE ORE BINS.

The inside bins will be used for coke and the bins next to the coke piles will be used for ore. The outside track on the left is for the transfer cars, of which there are two at present. It is 94 feet 4 inches from the center line of the bins to the center line of the furnaces. The span of the ore bins from column to column is 31 feet ½ inch.

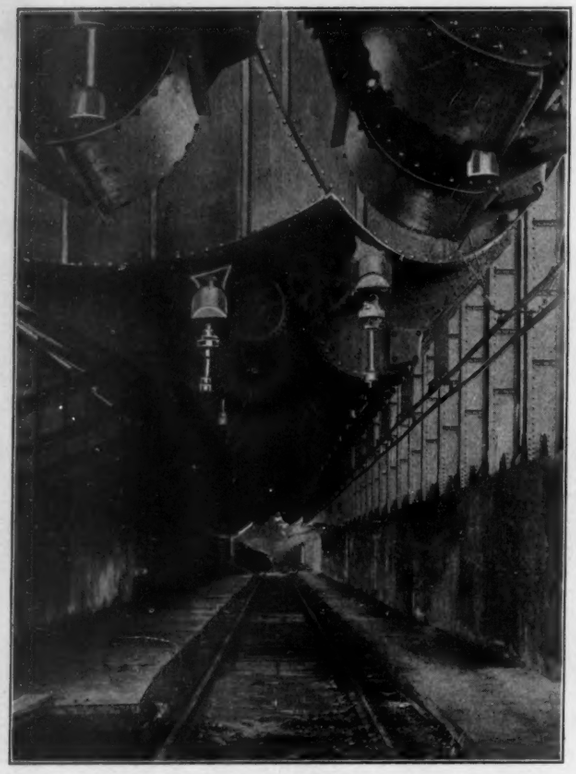


FIG. 15—LARRY TUNNEL UNDER THE ORE BINS.

One noteworthy feature is the overhead T-iron trolleys shown at the right. Projecting down from the bins are keys. These fit over plugs on the larries, making a mechanical connection between the motor on the larry and the gearing above which opens the foot valve of the bins. The plug on the larry may be raised and lowered by means of a lever. In this manner the complete transfer of the material from the bins to the skip is accomplished by the larry driver without leaving his position.

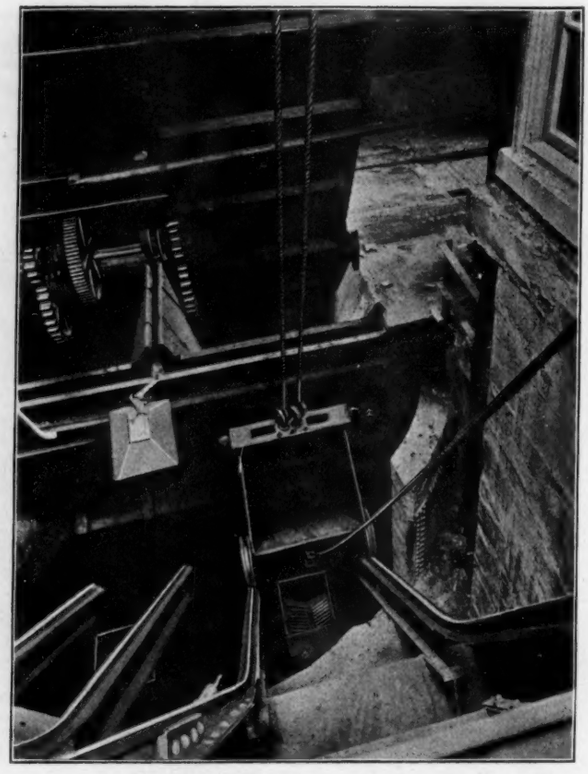


FIG. 16—VIEW LOOKING DOWN INTO THE SKIP PIT.

The window at the right shows the location of the skip operator. The bottom of the 270-ton coke bin located over each skip way is shown, with the gearing and motor for opening the bottom valves of the bins. These are controlled by the skip operator from his position.

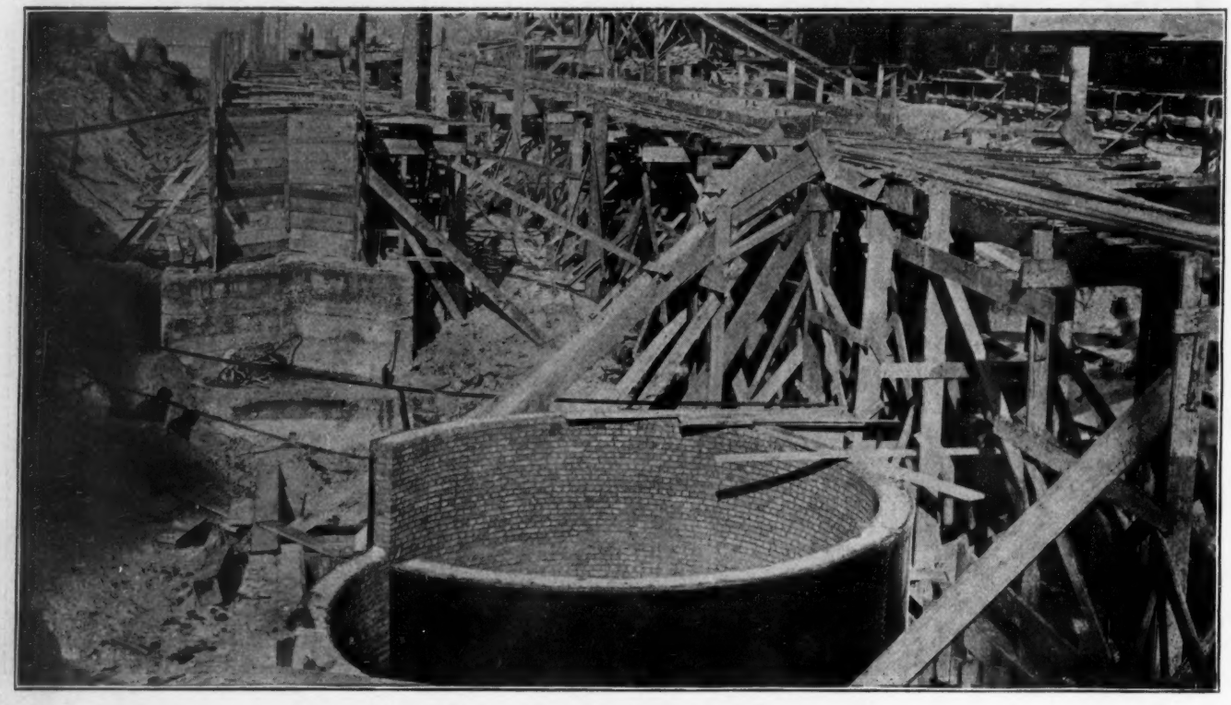


FIG. 17—THE SKIP TANK DURING CONSTRUCTION.

The skip pit extends down below water level. This required that sheet piling be driven before excavating for and putting down the steel shell.

ore yards and ore bins. At present the middle half of this length has been completed.

The capacity of the ore yards exclusive of the ore bins provides for the handling and storing of 320,000 tons of ore for each furnace or what will be, very easily, ten months supply under ordinary conditions. The ores already at the plant include Group No. 3 and No. 4 and Vermont ore from the Mesabi range, Chapin from the Menominee, Bernhart from the Marquette range and Vermilion lump from the Soudan mine in Minnesota, all non-Bessemer.

The ore yards are divided longitudinally by the walls on which the unloaders and bridges are carried. This permits of a complete separation of the different ores. An ore trough with a capacity of 35 tons per lineal foot extends the full length of the ore yard. Ore in transit from boat to stock pile is temporarily deposited here by the unloaders and again picked up by the bridge. The trough is V-shaped with a curved bottom to facilitate the handling of ore. To prevent the breaking up of the concrete on account of the buckets striking it the bottom is re-inforced by 75-pound steel rails.

The ore-handling equipment consists of five Hulett electrically operated, vertical steel leg type, unloaders, and five Hoover & Mason ore bridges. A complete description of this unloader may be found in THE IRON TRADE REVIEW, May 14, 1908. The unloading machines are heavier than preceding types and weigh approximately 850 tons. The bucket has a capacity of 10 tons and the unloader will average 500 tons per hour in unloading the first half of a cargo. The improvements in this machine are concerned very largely with the use of this built-up steel bucket leg and the manner of operating it. It is extremely flexible. The leg can be rotated through an angle of 320 degrees. The bucket itself is so contrived that one scoop may be telescoped to give it a reach of 15 feet 4 inches from the center line of the column. This enables fully 90 per cent of the cargo to be unloaded without hand shoveling and in some cases as much as 97 per cent. It has a maximum reach of 53 feet 9 inches at a depth of 8 feet 2 inches below the water line or 26 feet 10½ inches on either side of the center line of the boat.

The span between the front and rear legs of the unloader is 62 feet 10 inches. In this space paralleling the slip are four tracks for shipping ore from Gary to other points. Cars spotted under the unloaders can be loaded direct. The ore trough wall on which the rear end of the unloader is carried is of solid concrete 8 feet across the top, 20 feet across the bottom and 26 feet 4¾ inches deep. It carries 100-pound rails.

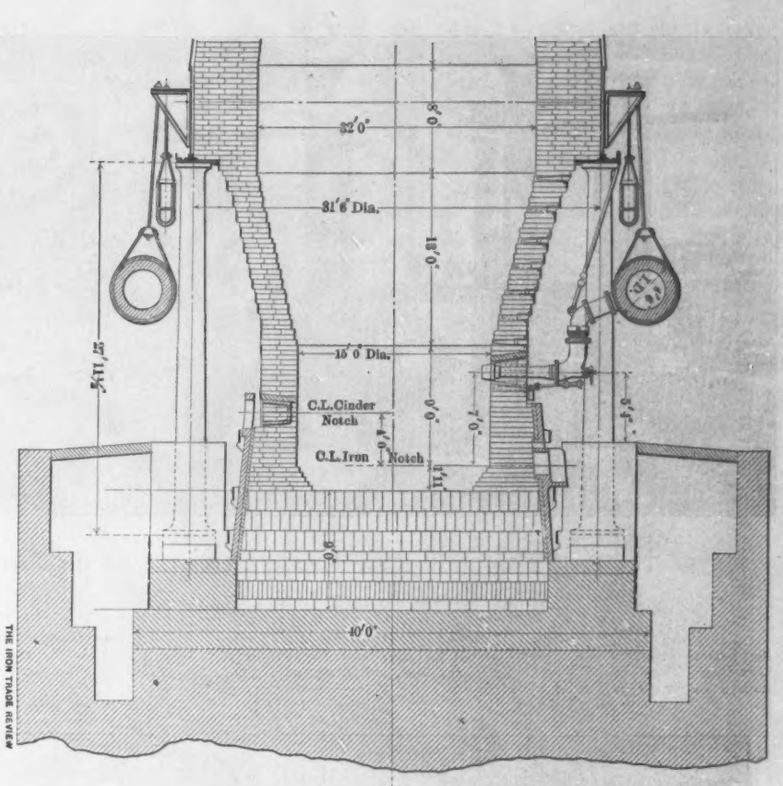


FIG. 18—CROSS SECTION OF THE FURNACE BOSHES AND FOUNDATIONS.

The unusual number of steel bands around the boshes is noticeable as well as the large number of cooling plates. The double hearth jacket is also unusual. The inside dimensions and lines of the stack represent about a happy medium of standard practice. The hearth bottom is built of fire brick to a depth of 9 feet. Below this is a concrete pier 40 feet diameter. Concrete retaining walls are continued upward to the usual height above the hearth level. The intervening space is filled with sand and the floor is paved with brick.

The ore bridges, in order to span the 425 feet from ore trough to ore bins, are unusually long, approximately 498 feet over all. They are built unusually high also, in order to clear the unloaders and have a clear height above the floor of the ore yards of 85 feet. The bridge buckets have a rated capacity of 15 tons. The particular feature of these bridges is the provision for swinging them through an angle of about 20 degrees or 75 feet either way. Where convenience requires that ore be deposited at some point in the ore trough not exactly opposite the point of final storage, one rotation of the bridge through the desired angle avoids the moving of the entire bridge back and forth through the short distance necessary for each bucket load. The bridges are electrically operated and have about the same track speed as the unloaders. The movement along the track is made positive by the use of a cable and drum.

The unloaders are operated along the tracks with power from a 75-horsepower motor, the hoist for raising and lowering the leg is drawn from a 150-horsepower motor and the bucket car is operated by a 200-horsepower motor. The ore bridges are driven by four 80-horsepower, four 40-horsepower and four 30-horsepower motors.

The ore, limestone and coke bins are of the Brown suspension parabolic type of heavy steel construction. The ore bins have a capacity of 13 tons per lineal foot and a total capacity of 20,000 tons of ore. The coke bins have a capacity of 4 tons per lineal foot and a total capacity of 6,160 tons. The bins will hold about 9 tons of limestone per lineal foot. All of the steel members of the bins, the deck spans connecting the bins and connecting trestles are designed with a factor of safety of five for live loads and of four for dead

FIG. 19—THE EIGHT CAST IRON BLAST FURNACE COLUMNS AND THE SETTING OF THE OUTER HEARTH JACKET PLATES.

Cast iron columns are used instead of structural steel columns. They are jacketed at the bottom and rest on a circular ribbed cast iron foundation plate which is built in eight segments. They are 27 feet 11½ inches high and designed to carry a load of 750,000 pounds with a factor of safety of about 15.

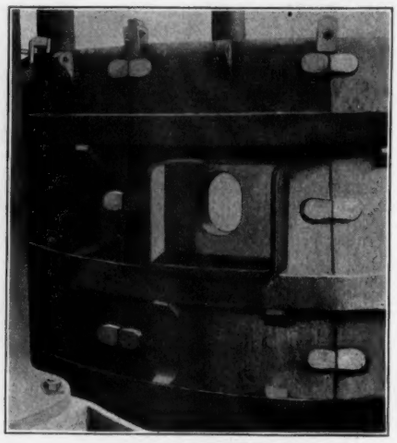


FIG. 20—OUTER HEARTH JACKET STEEL CASTINGS.

This jacket is made up of 12 sections and is 5 inches thick. It is not cylindrical. The cinder notch opening is shown directly in front. Solid lugs are cast on each segment as shown and forged links are shrunk on to these lugs. Heavy steel bands carried on solid bosses and pulled up with turnbuckles are also used in tieing the sections together. The inner jacket is the cooling jacket and is 3 inches thick, carrying water cooled pipes.

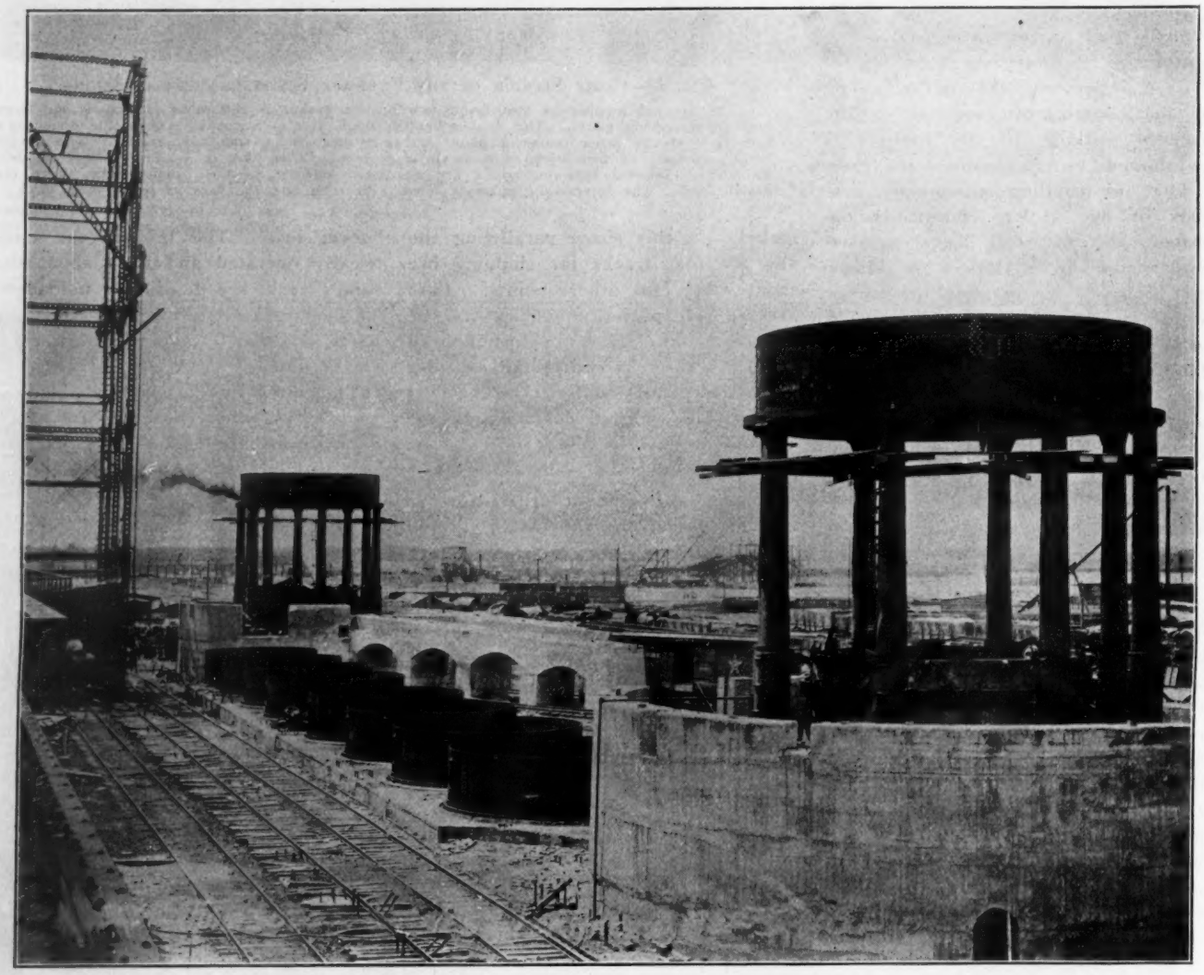


FIG. 21—CHARACTERISTIC FEATURE OF THE ERECTION METHODS ON ALL THE FURNACES.

The furnaces were erected in pairs, and in each pair both fur naces and each battery of stoves were erected at the same rate so that the same operations were carried on simultaneously. The second pair of furnaces in the group of four furnaces was one stage behind the first pair. This facilitated the handling of material and avoided confusion.

and wind loads. In addition to the large capacity for ore, coke and stone, the loading of which into the bins is a consideration in calculating the live load, there are on top of the bins the unusual number of four standard gage tracks. These are spread 6 feet 6 inches between centers. Three tracks are used for standard railroad equipment service, in the delivery of coke and stone. The fourth is used for transferring ore from the ore bridges to the bins in 60-ton transfer cars. It is apparent that unusually heavy concrete foundations and steel construction were required. The foundations are of mass concrete and contain about 10 cubic yards of concrete per lineal foot. The supporting trestle is built of heavy structural steel columns carrying heavy plate girders. The span of the girders from center line to center line of columns is 31 feet ½ inch.

The completed bins are arranged in three sections separated by two trestles, one 364 feet 9 inches long and the other 279 feet 4 inches long. One section consists of two ore and two coke bins 112 feet 8 inches long; the second section consists of one ore bin and one coke bin 197 feet 2 inches long and the third section consists of four ore bins and four coke bins 281 feet 8 inches long. The total length of the bins from center to center of end bents is 2,192 feet 8 inches. The bins are arranged in panels of which there are 110 in all, each 14 feet 1 inch long. All of the ore panels are uniform. All of the coke panels are also, except for a large central coke bin installed opposite each furnace for the direct discharge of coke to the skip. This bin has a capacity of 270 tons of coke. Each of these bins is equipped with an electrically operated bottom gate which is controlled by the operator of the skip hoist. The purpose of the bin is twofold. With 12 hours' supply of coke directly available, the charging of coke into the stack can be made temporarily independent of the operation of the larry cars using the bins. But one handling is required for the coke which is taken from the large bins as compared with two from the others. This is considered to be a large factor in fuel cost.

Each panel length of ore and limestone bins is equipped with two bottom spouts and gates and each coke bin panel with one spout and gate. The driving shaft and gearing for opening the gates are hung from the bottom of the bin. The opening of the gate is controlled from the larry, operating in the tunnel beneath the bins. The ore bin trestle will slope down to ground level at both ends, eventually, and be a part of the loop system. Between furnaces Nos. 6 and 7 and between furnaces Nos. 10 and 11 are the crossover switches for the ore bin tracks and at these points there are no bins for a distance corresponding to the length of the trestle sections mentioned above.

Two transfer cars operate on top of the ore bins. Into them the ore is discharged from the bridge buckets carried to whatever bin is desired. These cars consist of a side dump steel hopper with three doors and a capacity of 120,000 pounds of ore. These hoppers are mounted on trucks of M. C. B. specifications. The car is electrically operated in every particular, including the mechanism for opening and closing the doors. It is equipped with two 50-horsepower motors hung from the main axles and current is taken from a trolley attached to the bins. The trolley connection permits of shifting the transfer car to any of the four tracks. The traveling speed of the cars is about 600 feet a minute when loaded and 900 feet a minute when light. The car carries one operator.

The transfer subway beneath the bins is unusually light and commodious. It is enclosed in permanent brick walls throughout its entire length. Windows are placed at intervals of a very few feet. In this tunnel ten electric larries are operated in transferring materials from the bins to skip cars. These larries have buckets of 120 cubic feet capacity which are carried on a special weighing mechanism. The balance levers are directly in front of the driver so that he may readily watch the quantity taken from the bin. The larry is electrically driven by a 21-horsepower car motor through a train of gearing. Current is taken

FIG. 22—BLAST FURNACE MANTLE, SHOWING THE DOME TOP.

The brackets shown carry only the top platform and the trolley runway. The distributor is carried on steel castings riveted to the shell. The methods used in erecting the stoves are also admirably illustrated. The versatility of these erecting towers is patent. The riveting on the stoves was done by portable hydraulic riveters as shown.

from an overhead trolley. The traveling speed with a full load is from 600 to 900 feet a minute. Another 21-horsepower motor is installed on the larry for operating the foot gates of the bins and each motor has a separate controler. Projecting down from each bin gate is a key through which a mechanical connection is made between the larry motor and the gearing above. A socket, located on the larry, may be raised or lowered by levers from the driver's position on the larry to fit over this key so that one man on each larry controls the complete transfer of material without moving from his position.

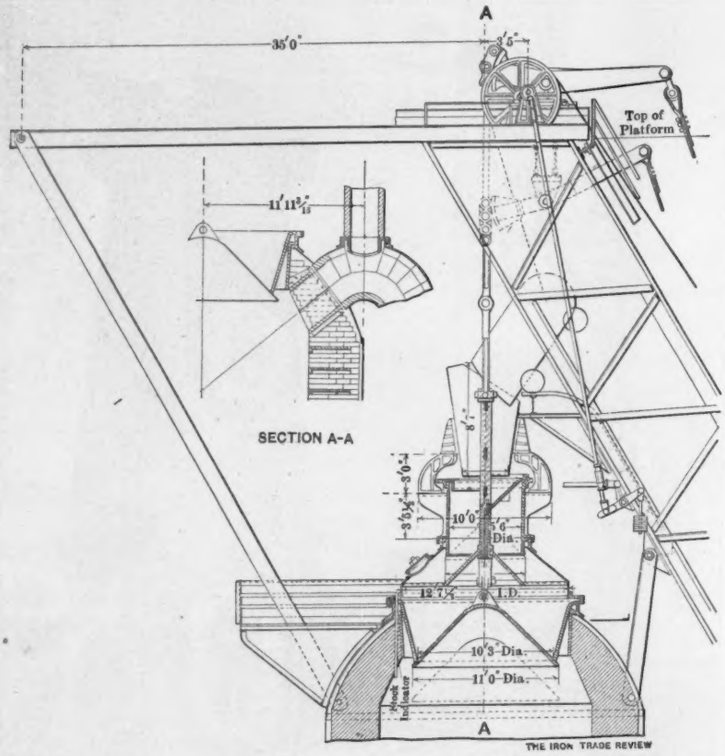


FIG. 23—CROSS SECTION OF BAKER-NEUMANN DISTRIBUTOR AND FURNACE TOP.

The top is practically of the Kennedy type, and will be operated closed. The manner in which the downcomer is taken off the top is somewhat unusual. The trolley runway extends out 35 feet from the center line of the furnace and the supports are designed for a load of 25 tons. With this heavy trolley it will be possible to set up the bells on the ground level and lift them complete and set them in place.

The details of design and the kind of auxiliary apparatus to be used with the blast furnace plant were worked out to a great extent at Pittsburg and South Chicago before the Gary plant was built. The arrangement of 16 stacks in one straight line with an absolutely uniform layout is unique and is even spectacular, with but eight furnaces erected. The advantages of the layout have already been mentioned.

In order to excavate for the foundations of the furnaces, stoves and ore bins, and in order to build the skip pit it was necessary to drive sheet piling to hold back the sand and some of the water. The site of No. 12 stack, upon which the first work was begun, is on the original shore line. The foundation work progressed from this point southward. The form of skip pit used here—a steel shell lined with brick—was first used at South Chicago. The construction was found desirable below water level, the bottom of the skip pit being 4 feet 3 inches below datum. In order to decrease this depth as much as possible the incline of the skip runway just above the pit was changed from 60 to 45 degrees, putting a curve in the tracks which is clearly shown in the illustration Fig. 16 looking down into the pit.

The concrete pier under the stack has an outside diameter of 56 feet and is 22 feet 1½ inches deep below the hearth bottom. The inner pier on which the hearth is built is 40 feet diameter and the top is at a height of about 24 feet 1½ inches above datum or 4 feet 1½ inches above ground level. Upon this 9 feet of brick is laid for the hearth bottom, the concrete being carried up around the brick for a height of 3 feet 4 inches. The outside of the pier is carried up as an enclosing wall to a height of 35 feet, from which the furnace level slopes up to a point 1 foot 8 inches above the iron notch or to a height of 17 feet 8 inches above ground level for the floor around the stack.

The center line of the piers for the cast house is parallel to the center line of the iron notch which is at an angle of 22½ degrees to the north and south line on which the stacks are laid out. The cast house center line is offset 8 feet 6 inches from the iron notch. The two arched concrete piers are 9 feet 6 inches across the top, 81 feet 6 inches long and have a slope on top of 1 foot in 12. Between the piers is a space about 17 feet wide. Into this a track is laid for the hot metal ladles. On the opposite sides of the piers the slag and auxiliary hot metal are delivered. There are three hot metal spouts delivering to the center track, three slag spouts to the outside track and two auxiliary hot metal spouts to the inside track. The hot metal and slag trains will be made up of three 40-ton ladle cars. The construction of the cast house is what might be called a skeleton type.

In the design of the stack proper no innovations have been attempted. The shell is noticeably heavy for a 450-ton stack and the banding of the boshes is much more secure than ordinary circumstances would require. There are in all 15 steel bands 1½ x 8 inches. There are seven rows of cooling plates in the boshes, one row for the tuyeres and cooling plates for the iron notch. These cooling plates are 27 inches deep and extend entirely through the walls. The brick lining of both hearth and boshes is 27 inches thick.

The hearth is 15 feet diameter, the depth from tuyere to cinder notch, 3 feet and from cinder notch to iron notch, 4 feet. From the center line of the tuyeres to the top of the crucible is 2 feet and the total depth of the crucible is about 10 feet. On the basis of 6,000 pounds of coke consumed per square foot of hearth area and assuming a consumption of 2,200 pounds of coke per ton of iron, these furnaces have hearth capacity for the production of 530 tons every 24 hours. Allowing 3 cubic feet of crucible capacity per ton of iron made, the furnaces have a capacity of about 580 tons

daily. It is apparent from both estimates therefore that the rated capacity of 450 tons is very conservative. The fact that it is expected to tap the furnace every four hours adds to the possibility of driving the stacks for a much larger production. The tuyere capacity also provides for this greater production. There are 12 tuyeres whose openings can be varied from 4 to 7 inches. The maximum opening would give a total area of tuyere opening of 461.76 square inches which would provide 46,176 cubic feet of air at the rate of 100 cubic feet of piston displacement per minute. An average requirement for a 15-foot hearth is 40,600 cubic feet. The bustle pipe has an area of about 1,018 square inches.

The boshes are 13 feet high and the bosh diameter is 21 feet 6 inches. This is according to standard practice both as to the batter of the bosh walls and the relative area at the bosh and hearth. The height of the inwalls is 40 feet and the inside diameter at the top is 16 feet. From the top of the inwalls the shell is cylindrical for a height of 11 feet 10 inches, above which there is a dome top of ⅞-inch plates shaped to a radius of 12 feet 6 inches. The total height of the stack from the center line of the iron notch to the top is 88 feet.

The hearth has a double jacket. The inner or cooling jacket is three inches thick and is built of cast iron, in 22 sections. The embedded cooling pipes are extra heavy 1¼-inch wrought iron pipe. The outer jacket is built in 12 segments, of steel castings 5 inches thick, bound together by steel bands which are continued around the circumference of the hearth and by steel links shrunk on to the solid lugs cast with the segments. A cooling gutter exends all around this outer jacket below the floor line. The water trough which acts as a header for all the cooling water circulation around the boshes and the hearth has a double compartment. The lower compartment is enclosed by a false bottom for the uppper gutter and receives the water under presure from the central pumping station. The circulating pipes are taken off of this compartment and returning, the water flows into the upper guter. From here it runs by gravity to the primary washers, the bosh water being used for these washers entirely.

The mantle of the furnace is carried on eight cast iron columns 27 feet 11½ inches long. Although this is an unusual height for cast iron columns, structural columns being preferred usually for more than 18 foot lengths, cast iron columns have been used very successfully at South Chicago. They are of better shape than built up columns and offer greater resistance to wear and tear. They are jacketed at the bottom to protect them in case of break outs. The cast columns are made very heavy and are designed to carry a load of 750,000 pounds with a factor of safety of about 15.

The top of the furnace is of standard design for closed top operation. It is equipped with a Baker-Neumann distributor. The skip bridge is heavy construction. The weight of the skip is carried by the ore bin foundation and the stack, but the steep angle of incline and the arrangement of the link by which the upper end is carried makes the weight component on the stack small, and in direction, causes it to fall within the center line of the furnace so that there is no overturning moment. The skips are operated in balance by an Otis Elevator motor-driven hoist. The hoist house is located under the bridge, but the controller for the hoist motor is in the operator's cage just above the skip pit. From this cage the skip operator controls the skip operation, the large coke bins and also the stock line test rods. The operator is also provided with a 4-light signal, showing in which quadrant of the stack the distributor will place the next load. In this way the entire charging of the stack is under the direct observation and control of one man.

FIG. 24—THE FURNACE BOSHES.

This illustration shows the very heavy banding of the bosh walls, the large number of bosh plates, the arrangement of circulation pipes and the generally trim appearance of the boshes. There are two rows of cooling plates at the tuyeres and seven rows of plates in the bosh walls. The temperature decreases from the tuyeres upward and so the two bottom rows of plates are in series on one set of circulating pipes, the next three rows on another series and the top four on the third series. The piping is shown in the view as is the piping from the inner hearth jacket also. Below the floor level the outer hearth jacket is also surrounded by a cooling gutter but there is no splashing water visible.

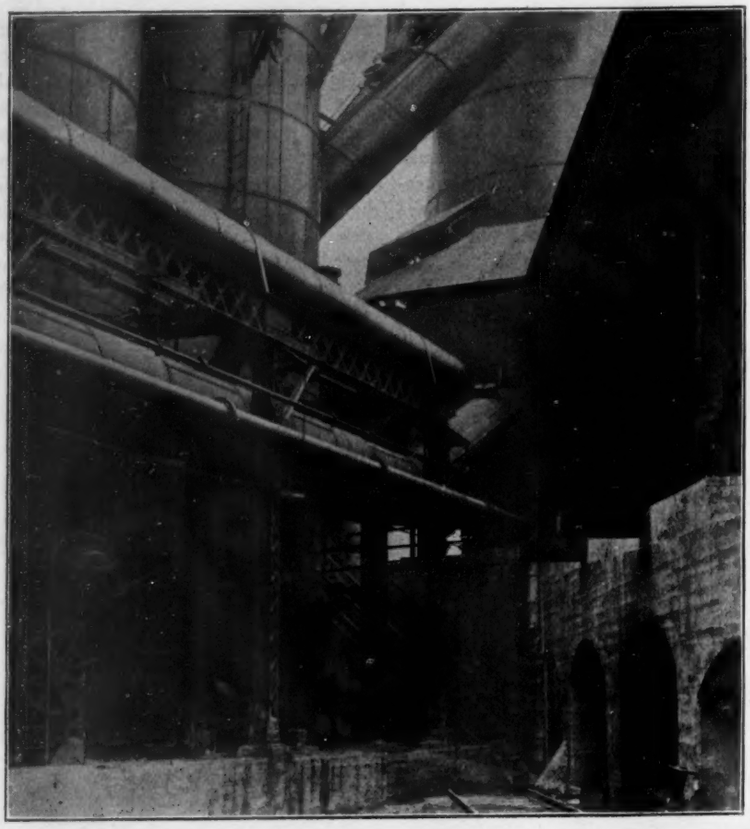


FIG. 25—RELATION OF THE CAST HOUSE, STACK, STOVES, DOWNCOMER AND HOT BLAST MAIN FOR FURNACES NOS. 5, 7, 9 AND 11.

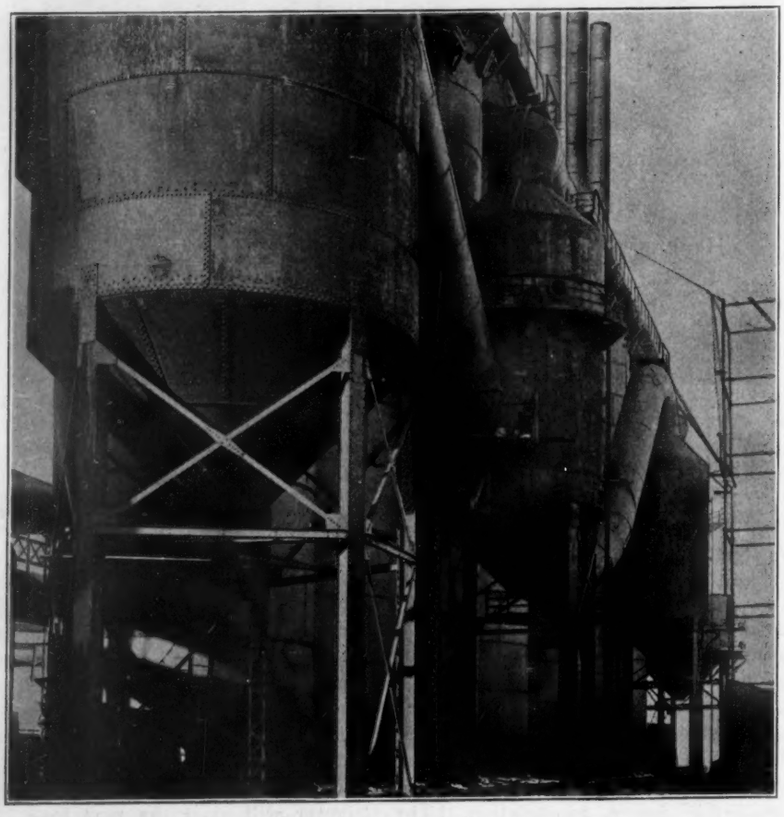


FIG. 26—THE DUST CATCHERS.

The economy of space in so locating them close up to the stoves will be noted. Immediately underneath is a track so that the dust may be discharged directly into cars for removal.

The cylinders for operating the bells are located in the hoist house. They are pneumatic cylinders operating on 10 pounds per square inch pressure. The air for operating is taken from the cold blast main and connection is made, continuous for all of the furnaces, so that with but one stack in blast the bells of all the stacks may be raised or lowered.

A description of the blowing engines and the calculations connected with the use of the blast furnace gas for power will not be attempted in this article but will be embodied in the description of the power plants immediately to follow. The course of the gas through the stoves and washing plant involves very comparatively few new features.

The gases pass off from the furnace through four branches which finally unite in two downcomers 5 feet 6 inches diameter. The gas connection is made through a heavy 130-degree elbow, taken off of the dome at an angle of 51 degrees and 15 minutes from the vertical. The gases in the downcomer have a velocity of about 20 feet per second and discharge into the bottom of the first dust catcher in the usual manner for producing a whirling motion of the gases. This dust catcher is 30 feet in diameter and 40 feet high. The gas passes out of the top and down through a main 7 feet 3 inches in diameter to a second dust catcher 14 feet diameter by 25 feet high. The dust catchers are placed as close to the stoves as possible, the distance from center line to center line being only 15 feet 6 inches. Inasmuch as the gas from both stacks passes from the second dust catcher into a common 10-foot main, the dust catcher is converted into a water valve when one stack is off and acts as check valve.

The gas goes from the dust catchers to the primary washers. These are arranged in groups of three for each pair of furnaces. One washer takes care of all of the gas from one stack, the third washer being thrown in while one of the others is being cleaned. These washers are a modification of the Mullin type. In the Mullin washer the gases are discharged against the surface of the water through tubes. The course of the gas and the principle of cleaning is the same in the Gary primary washers, except that a funnel is used instead of a cylindrical tube to bring the gases down, and instead of tubes the lateral surface of the funnel is deeply fluted. The gas immediately expands at the top of the funnel into these

convolutions and is broken up in the same degree as where tubes are used and at the same time without the possibility of the passage of the gas being clogged with dust.

A track runs directly under the washers so that they may be cleaned directly into a car. Concrete draining basins are built around the track from which the water runs off into settling basins 5 feet 9 inches deep by 7 feet by 20 feet. The gas in passing through the primary washers is only cooled from 100 to 150 degrees and should have a temperature of about 400 degrees Fahr. on returning to the stoves.

The gas is divided after leaving the primary washers, about 30 per cent or a little less proceeding to the stoves and the remainder passing over to be again divided, about 7½ per cent to the boilers and the remainder to the Zschocke washers. There are four stoves for each stack. They are of the improved McClure type, 22 feet in diameter by 95 feet high, having a total heating surface of about 200,000 square feet. The stoves are mounted on rails of 80-pound section which provides for such expansion at the bottom as may take place. A quick opening snort valve has been put on these stoves. It is an adaptation of the by-pass valve and can be operated very quickly by means of a lever instead of a hand wheel. Provision is made for renewing the chimney valve and seat more readily than formerly by supporting the chimney on four struts, one of which is so designed that it can be removed, permitting independent access to the valve. A feature of the stoves and furnaces also is the unusually ample stairway and platform facilities and the placing of hand rails at all hazardous places.

The secondary washing of the gas is accomplished in a series arrangement of Zschocke and Theisen washers. Both of these washers are familiar types. The Zschocke washers are vertical cylinders 14 feet in diameter and 50 feet high. The upper half is filled with a pile of horizontal grids through which the water passes downward and the gas upward. The lower half is filled with umbrella-shaped baffle plates which are in series with the grids above. This arrangement is a modification of the methods used at Edgar Thomson only in that the grids and baffles are in separate washers each about 25 feet high. The gas goes directly from the Zschocke to the Theisen washers. There are eight of each kind. The velocity of the gas has been reduced by this time to not more than 3 or 4 feet a second. It is forced into the Theisen washer, which

FIG. 27—STOVE FOUNDATIONS BETWEEN FURNACES NOS. 7 AND 8.

Two courses of brick are laid on the concrete bottom. Rails of 80-pound section are then placed as shown. A cement wash is filled in around the bottom flanges so that the rails are permanently set with the brick. The stove steel is then laid directly on the rails.

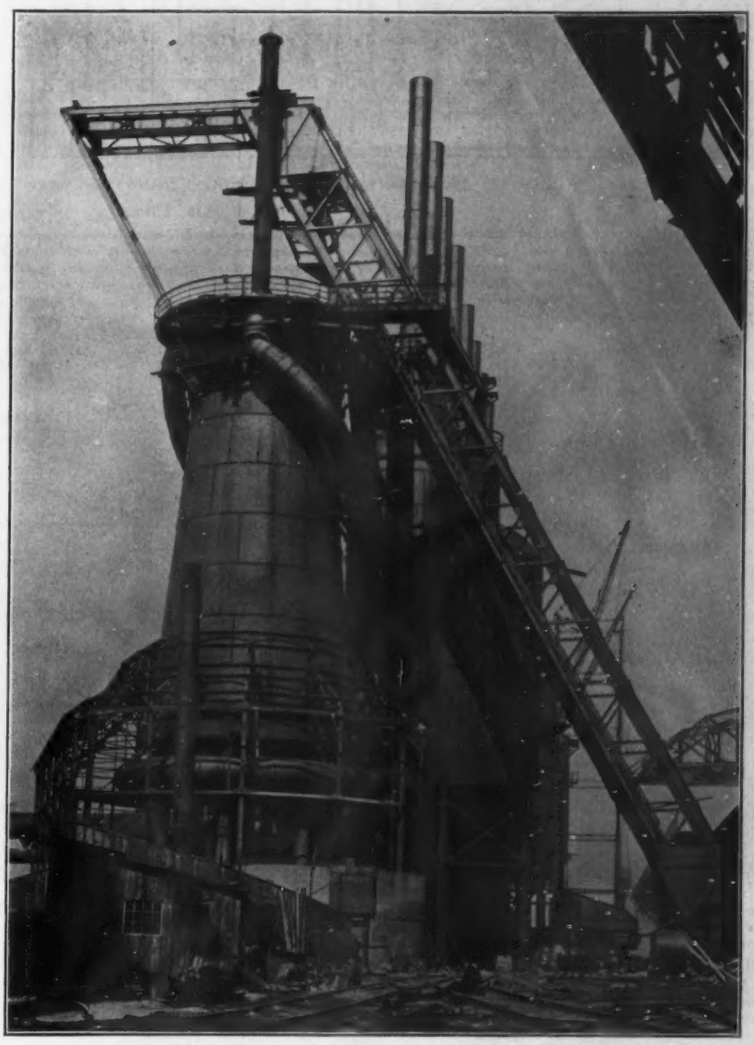
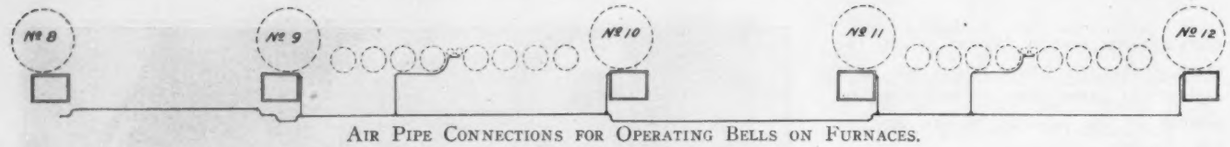
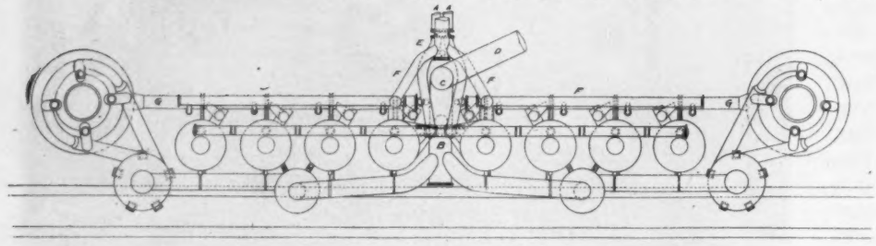


FIG. 28—FURNACE NO. 11 SHOWING THE SKIP BRIDGE.

The skip bridge is inclined at an angle of 60 degrees and is of unusually heavy construction. It has a span of 125 feet between supports and carries a double track. The trolley supports are unusually heavy, having to carry a 25-ton trolley load.



AIR PIPE CONNECTIONS FOR OPERATING BELLS ON FURNACES.



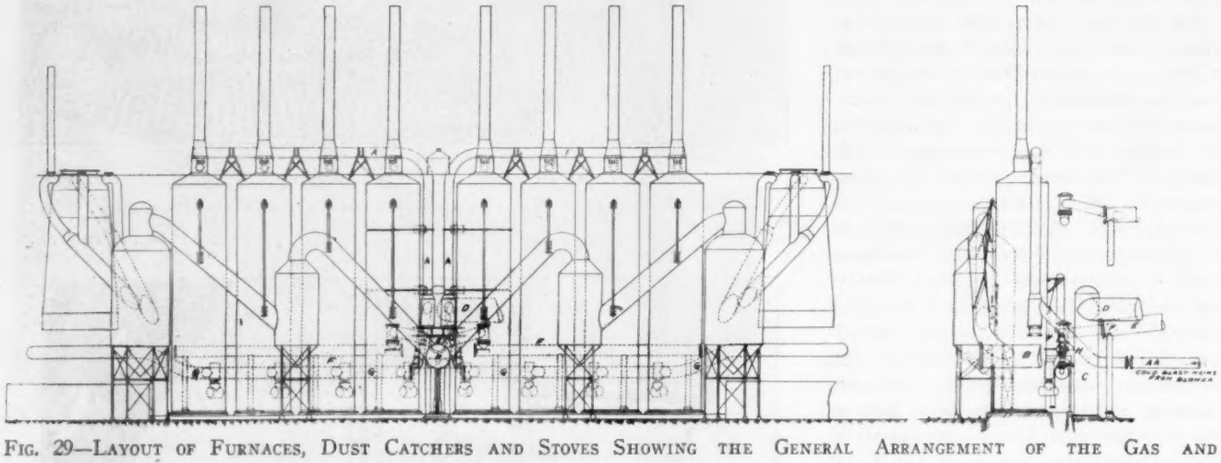


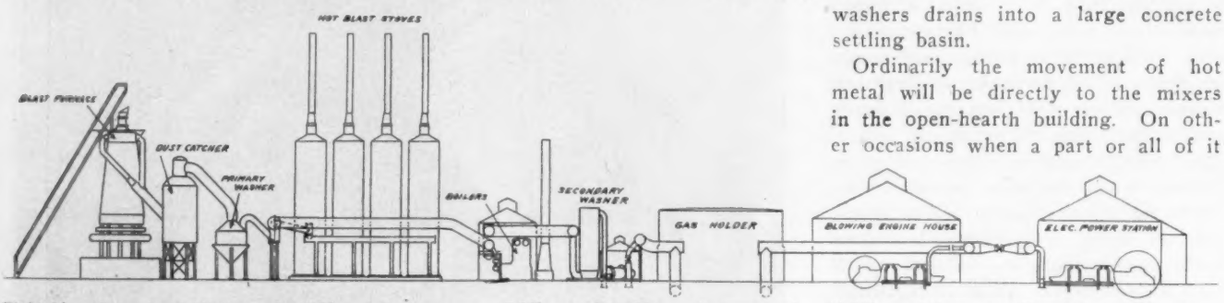
FIG. 29—LAYOUT OF FURNACES, DUST CATCHERS AND STOVES SHOWING THE GENERAL ARRANGEMENT OF THE GAS AND AIR PIPES.

The noteworthy features are the use of two dust catchers, both located close in to the stoves; the gradual enlargement of the gas mains for the reduction of the velocity of the gases; the common 10-foot header with up-take and dust leg, leading to the primary washer main; the use of two cold blast mains instead of one; the arrangement for carrying both the gas and cold blast mains over the furnace tracks on the same towers. (AA) Cold blast mains, risers and headers to stoves. (B) Cross header carrying gases from dust catcher to riser and dust leg (C). (D) Gas main to primary washers. (E) Return header from primary washers carrying about 30 per cent of the gas back to stoves. (FF) Hot gas mains to stoves. (GG) Hot blast mains to bustle pipe. (H) By-pass from cold to hot blast mains.

revolves at 850 revolutions a minute, and is thrown against a film of water. The purification is complete to the extent of leaving approximately 0.01 grain of solid matter per cubic foot of gas. The requirement of cleanliness for gases to be used in gas engines is about 0.1 grain of solid matter per cubic foot of gas. The Theisen washers are driven direct by 150-horsepower motors. Current is obtained through three water and oil cooled 6,600/440-volt transformers. Average practice has shown that for each 1,000 cubic feet of gas the costs of the Theisen washer are as follows: Installation, $23; water consumption, 9 gallons; power consumed, 0.15 horsepower; operating expenses, 3.8 cents.

The gas from the Theisen washers is delivered to two gas holders, 90 feet diameter with 30 feet of travel and a capacity of approximately 200,000 cubic feet. The water from the washers drains into a large concrete settling basin.

Ordinarily the movement of hot metal will be directly to the mixers in the open-hearth building. On other occasions when a part or all of it



Eight blast furnaces, 3,600 tons pig iron in 24 hours. Total blast furnace gas produced per hour, 22,450,000 cu. ft. = 100%. Equivalent to 250,000 brake horsepower (in gas engines).

30% used here or 6,750,000 cu. ft. per hour.

7.5% used here or 1,700,000 cu. ft. per hr.

2.5% used here and in primary washers, or 600,000 cu. ft. per hour.

12.5% used here, or 2,800,000 cu. ft. per hour. 2.5% used for auxiliaries, for blast furnaces themselves (in gas engines) or 600,000 cu. ft. per hour. Total for furnace operation 15% or 3,400,000 cu. ft. per hour.

Remaining 45% or 10,000,000 cu. ft. per hour available for other purposes. Equivalent to 110,000 brake horsepower (in gas engines), with gas at 90 B. T. U. per cu. ft. and 10,000 B. T. U. per brake horsepower hour.

FIG. 30—DIAGRAM OF GAS DISTRIBUTION FROM THE FURNACES TO THE STOVES, BOILER HOUSES, SECONDARY WASHERS, BLOWING ENGINES AND POWER PLANT.

is not required at the open hearths it is diverted to the pig casting plant. Similarly with the slag, which will ordinarily be run into ladles and used for filling, provision has been made for granulating the cinder whenever desired. Between each pair of furnaces, alternating with the primary washers, is a granulating tank 154 feet long by 17 feet wide by 22 feet deep and built of concrete. The cinder is granulated by a stream of water directed against it as it falls from the slag runner into the tank.

The pig casting plant is undoubtedly the most advanced type thus far designed. As regards capacity, it is intended to be capable of handling the entire output of the furnaces, as it will be called upon to do regularly when the open hearths are off. In the matter of lay-out, the chief consideration has been independence and freedom of operation, both for the handling of the hot metal ladles and in loading the pigs. The plant consists of a cast house, six two-strand Uehling pig machines with cooling conveyors, a ladle repair house, skull cracker and scrap yard.

The cast house is 82 feet wide by 393 feet long, with a clear height under the trusses of 54 feet. The building can be extended 300 feet to the south to accommodate five additional pig machines. Two 75-ton cranes with 15-ton auxiliaries span the building, in addition to which a 10-ton repair crane is installed. On the east side of the cast house a cleaning platform 15 feet wide extends the full length of the building. On the opposite side are the pouring troughs. Between, three ladle tracks with cross-overs run through the building on the ground level.

The pig machines are of a standard type and are 115 feet long. Each machine discharges to a cooling conveyor having a tank 99 feet long. The pigs are conveyed through this tank, submerged in water before being discharged into the cars. The machines and conveyors are set at an angle so that an arrangement of the loading tracks has been possible whereby each conveyor discharges upon its own individual track quite independently of the other machines. The loading tracks constitute a gravity yard so that cars may be fed down from the main track by gravity on a 1¼ per cent grade. There is room for the storage of seven cars on each of these tracks.

The pig machines are driven by 40-horsepower induction motors and the

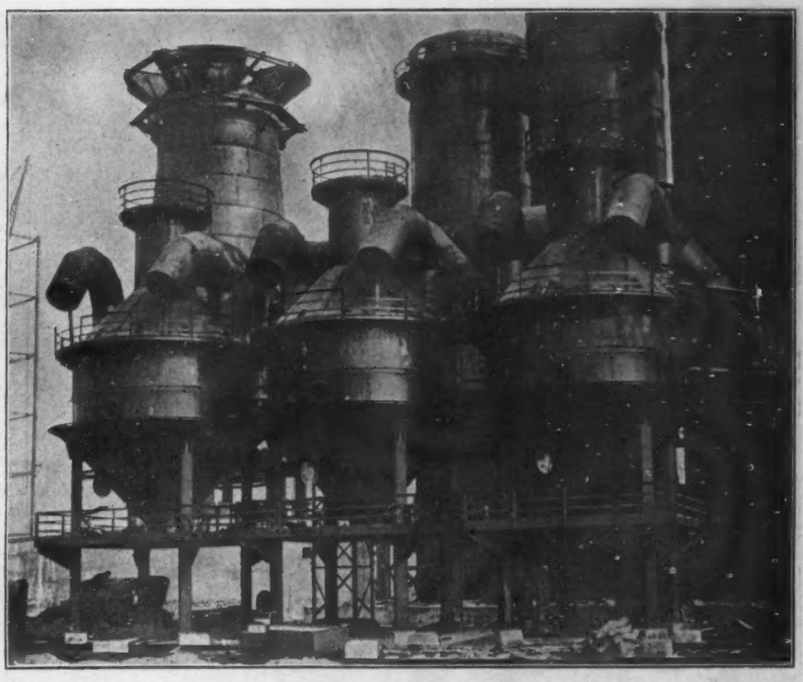


FIG. 31—THE PRIMARY WASHERS.

These washers are a modification of the Mullin type, having instead of a cylindrical tube sheet with inserted flues for the projection of the gas upon the water, an inverted funnel with a deeply fluted lateral surface. There are three washers for each two furnaces, one washer for each stack and an auxiliary. There are shallow concrete basins directly under the washers which drain into a concrete settling basin on one side. A railroad spur runs under the washers and a car may be spotted directly beneath and the accumulated dust dropped into the car direct from the foot valve of the washer.

FIG. 32—A BATTERY OF EIGHT ZSCHOCKE WASHERS

This battery serves furnaces Nos. 9 to 12. The gas washing system at Gary is similar to that at Edgar Thomson except in the arrangement of the Zschocke washers. The Gary washers include in one shell of twice the height what is in two Edgar Thomson washers arranged in series—namely a pile of horizontal grids in the upper half and a succession of umbrella baffle plates in the lower. The elbow shown half way between top and bottom is the entering connection for the gas. The gas enters from the main through a vertical dust leg which is bolted to this elbow. The gas passes off at the top of the washer and down through the other pipe to the Theisen washers.

FIG. 33—THEISEN WASHERS IN COURSE OF ERECTION.

This shows the interior construction of these centrifugal washers. The blowing engine house is immediately in the rear and the second set of eight Zschocke washers will be erected immediately in front. This is the installation for the second set of four furnaces now under construction.

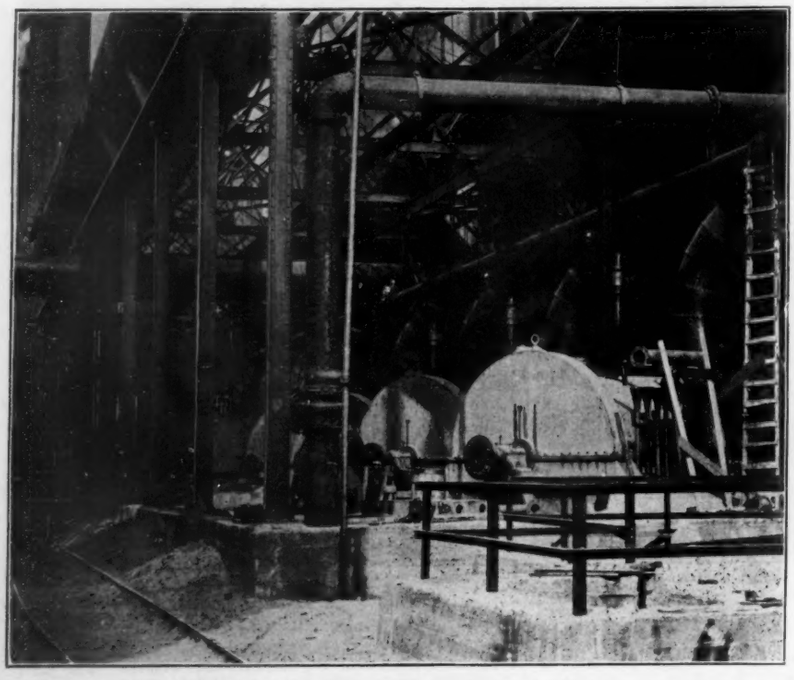


FIG. 34—COMPLETE INSTALLATION OF THEISEN WASHERS.

Their location relative to the Zschocke group is shown. In the foreground are the large settling tanks of concrete.

cooling conveyors by motors of 30 horsepower.

The method of pouring the hot metal into the pouring trough is unique. It may be termed lip pouring as contrasted with other methods, where the ladle turns about its trunnions in pouring and begins to spill the metal when the lip is still several feet above the pouring pot and ends with the lip practically in contact with the pouring pot. The loss of metal from splashing is considerable under such conditions. To avoid this wasteful splashing, the ladle is set in a pouring cradle which is pivoted at a point directly under the lip of the ladle. This entire cradle is then tilted in such a manner that the ladle practically turns about the end of the lip as a center with the result that at every stage of the pouring the hot metal falls through a nearly constant and a minimum distance. The pouring device consists of a ladle stand directly in front of each pig machine. This stand comprises two upright frames, at the upper ends of which are pivoted the ladle cradles. The lower ends of the cradle are tied together by a cross-head, to which attachment is made for tilting. When not being tilted the bottom ends of the cradle rest on the stand.

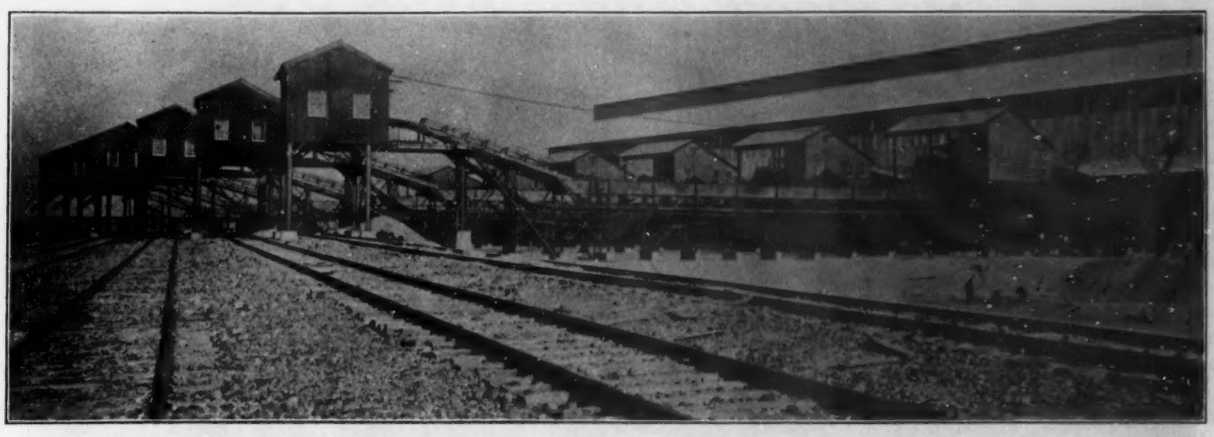


FIG. 35—DELIVERY END OF THE COOLING CONVEYORS.
Showing the offset in the tracks and each conveyor to provide independent loading. This is a gravity yard with a grade of 1¼ per cent.

The cradles are tilted by means of jib cranes which swing out over the ladles from the wall. To protect the boom of the crane from the heat of the metal in the ladle is it faced with asbestos. The crane is operated by a motor-driven hoist at one side. After a ladle is poured it is picked up from the cradle by the overhead crane, by means of which it was also lifted from its truck when first brought to the cast house and placed in the pouring cradle. It is carried to the cleaning floor where it is cleaned and the lip relined. It is then again picked up and returned to its own trucks.

The ladle repair shop, scrap yard and skull cracker are arranged in a row with the runway on which a 50-ton crane is operated, extending through all three continuously for a length of 460 feet. This runway has a span of 75 feet which is the common width of the three departments and a height to the top of the rail of 32 feet 6 inches. The crane has a 15-ton auxiliary and is used both for lifting and for pulling the ladle trucks and scrap cars along the surface tracks.

The ladle repair house is 200 feet long and in addition to the main floor under the crane it has a 30-foot lean-to for the storage of brick, a clay storage and mixing room and a tool room and repair shop.

Two ladle tracks traverse the building entering from the north end. A spur track also runs into the building on which trucks are repaired and from the opposite end a track for the removal of scrap leads out through the scrap yard and skull cracker. Six ladle dryers are arranged along one side of the building. These dryers consist of a ladle stand and an installation of gas burners arranged with a hood to project a heating and drying flame against the ladle lining. The gas for these burners is generated in a gas producer located in the building. In front of the brick shed storage are four relining pits.

The scrap yard is a storage space 120 feet long and 75 feet wide surmounted by a framework for carrying the crane runway, and traversed by the scrap track. The skull cracker consists of a skeleton frame work 100 feet long, 79 feet 6 inches wide and 70 feet high to the bottom of the

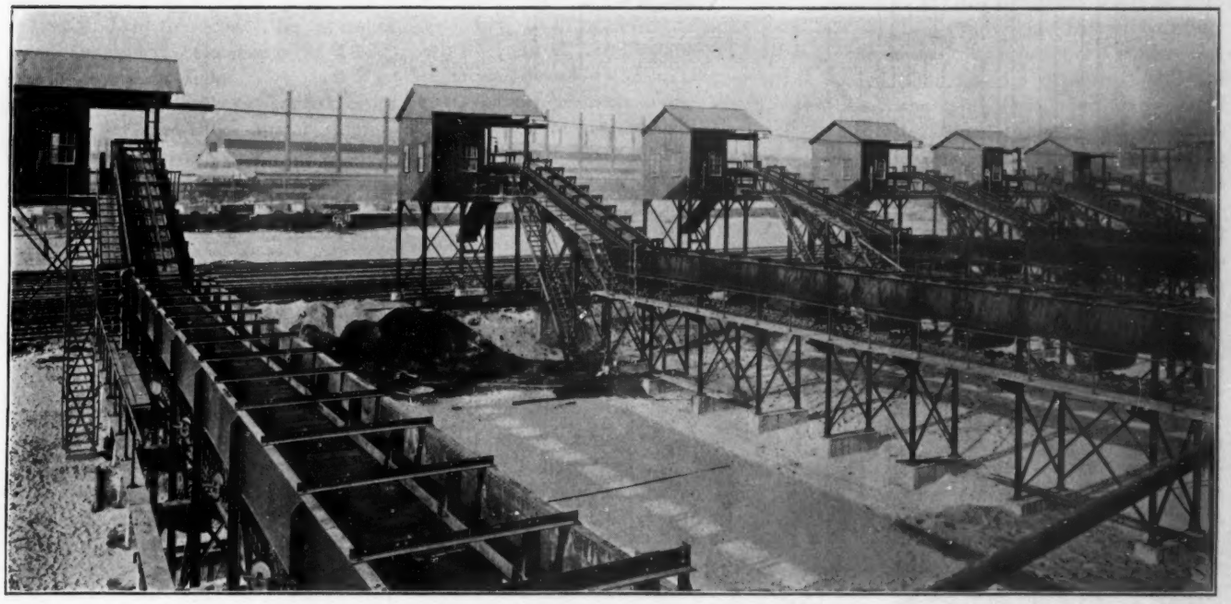


FIG. 36—ANOTHER VIEW OF THE COOLING CONVEYORS FOR THE PIG CASTING PLANT.

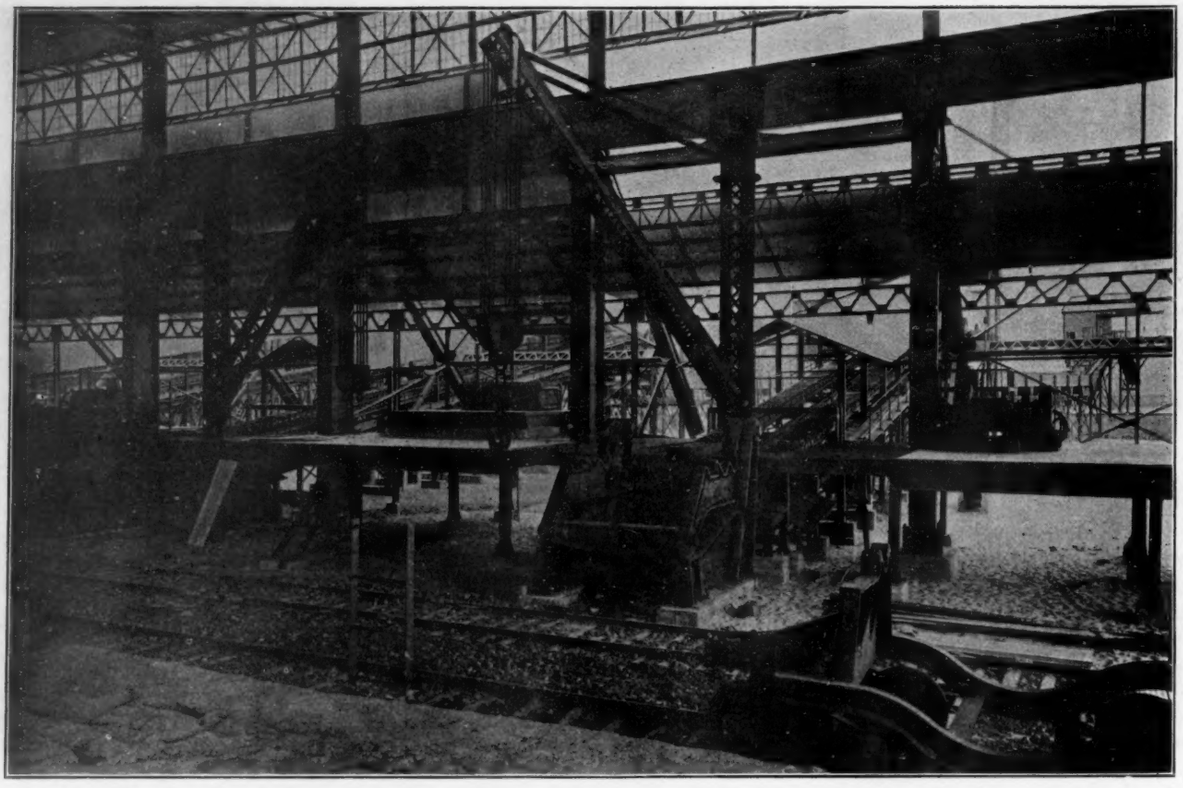


FIG. 37—INTERIOR OF THE PIG CASTING HOUSE.

This illustration shows the ladle tilts and the pouring end of the pig machines. The wall crane shown is used for tilting the ladle cradle. The crane hook engages the cross-head shown in front. This cross-head is mounted in bearings in the cradle frame and is free to turn. The entire cradle is then tilted. The hoist shown to the right is motor driven and operates the jib crane hook. The wooden bin between the machines is used for the preparation of the lime wash.

top bracing. This framework also carries a 40-ton crane, the runway for which is 27 feet 6 inches above the 50-ton crane, and has a span of 77 feet 6 inches. The 40-ton crane has a 10-ton auxiliary. The total height of the runway of the top crane is 60 feet. This crane will be provided with an electric lifting magnet.

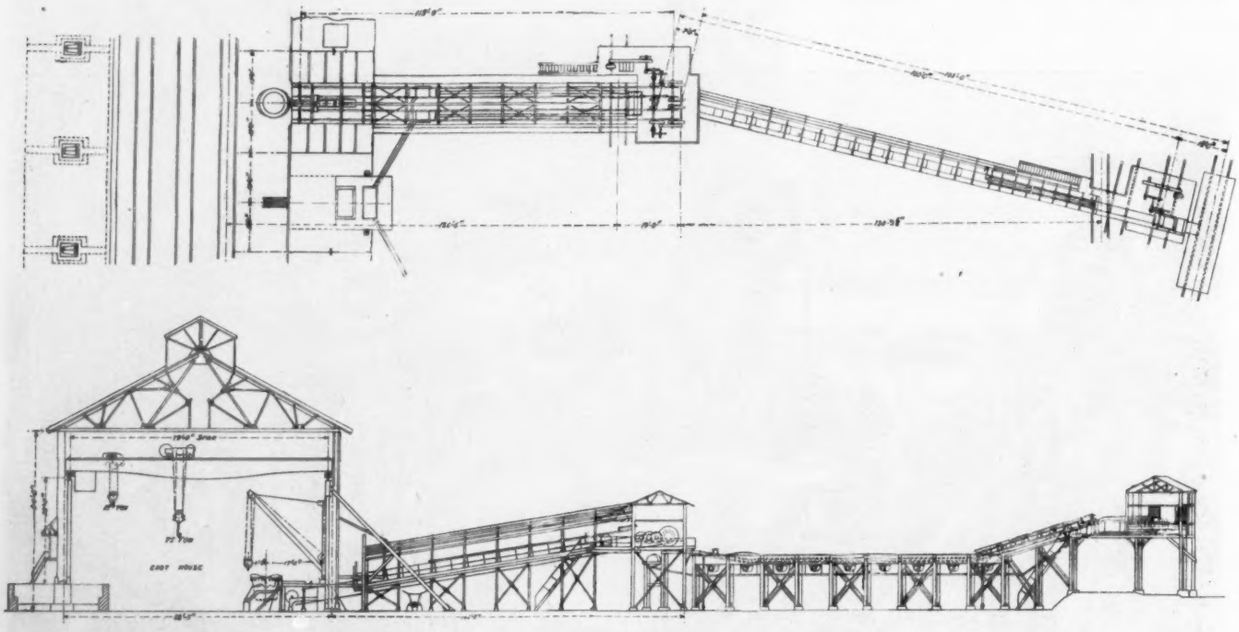


FIG. 38—CROSS SECTION THROUGH PIG CASTING PLANT.

The pig casting machines are 115 feet long and the cooling conveyors 99 feet long. Each machine has an average operating capacity of a ton every two minutes.

AN ENGINEERING PROBLEM

By B. H. Reddy[1]

In the practice of the various branches of engineering, it not infrequently occurs that some peculiar condition will confront the engineer with a difficulty he has never before encountered. In the solution of the problem before him, he may not have the valuable aid of data or experience with a similar difficulty, and under these circumstances, about all that remains for the engineer to do is to make a careful study of all the data obtainable, relating to the case under consideration, and then use his best judgment. During his experience, the writer was at one time engaged in the design of some heavy presses. These presses were of massive design and developed a pressure between the platens in excess of 2,000 tons. They consisted of an upper and a lower platen, with the necessary machinery for moving the lower platen, the upper platen being stationary.

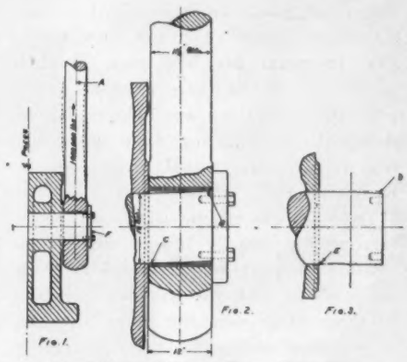
The lower platen was drawn upwards between vertical guides, by means of forged steel links, which were in turn actuated by a large cylinder and a combination of toggle levers. The main links were 11½ inches in diameter, and were bored at each end for a neat working fit on forged steel pins. The two pins in the lower casting were prevented from turning by means of keys of ample dimensions. In the upward travel of the platen the main links moved about the pins through an angle of perhaps 35 degrees, while under pressure. In this case the pressure was somewhat exceeding 1,000,000 pounds on each link.

In Fig. 1, is shown a partial cross section, through the lower platen, showing the general construction. To prevent the main links from working off the pins cast iron caps were attached to their ends by means of four studs, 1¼ inches diameter. On some of the presses, the pins in the lower platen had a habit of moving very slowly, but also very surely, towards one end or the other. The slowness of the movement was shown by the fact that trouble arose only after weeks of constant use, while the sureness of the movement was demonstrated by the fact that the four and sometimes six, studs were broken. Forcing the pins into the casting under hydraulic pressure was tried and some pins were made with collars, so they could not be pulled through. Those pins which had been forced into the casting worked loose, while those with collars not infrequently traveled in the opposite direction.

It became clear that the problem was not thoroughly understood. In the design of the first few presses an engineer of long experience on other classes of work had been engaged. For the diameter of the pins, it was natural that he should apply the formula

$$WL=M \qquad (1)$$

Where W=pressure in pounds on pin. L=length in inches. M=bending moment, in inch-pounds. S=section modulus. f=extreme fiber strain



The Pin That Gave Trouble.

per inch. Substituting the corresponding values in (1) 1,000,000×6=6,000,000=M. In this case 6 inches was the distance from face of casting to center line of the link. The diameter of the pins in the original presses was 18 inches and using this diameter in the formula (2)

$$0.0982\times d^3=S \qquad (2)$$

we have $0.0982\times 18^3=572.7=S$. Using the formula (3)

$$\frac{M}{S}=f. \qquad (3)$$

and substituting the values previously obtained from (1) and (2) we have $\frac{6,000,000}{572.7}=10,476=f.$ So far as this stress alone is concerned, no fault could be found; however, from previous experience, it was known that the diameter of 18 inches was unnecessarily large, causing needless weight and expense. When changes were suggested, and a diameter of 14½ inches for the pins was advised, the engineer who designed the original presses strenuously opposed the changes, saying he knew the pins would be too light. Nevertheless, the presses were finally built with the pins 13 inches in diameter. Quite a number of these presses have since been built, and the writer has learned of but two pins being broken, and these were broken by the failure of the lower platen, which was in two pieces.

If we substitute the diameter of 13 inches in (2) we get $0.0982\times 13^3=215.745$, this value being only 37.67 per cent of the strength of an 18-inch pin. Substituting again in (3)

$$\frac{6,000,000}{215.745}=27813=f.$$

If we assume this method of calculating the proportions of the pins to be correct, a stress of 27,813 pounds per square inch is entirely too high, and could not be used at all in this class of work. However, previous experience had demonstrated that the bending moment could be neglected, and the diameters calculated for shear alone. If, therefore, the pull on the link be divided by the area of the pin, the result will be the shear per inch. In this case $\frac{1,000,000}{132.7}=7,536$ pounds per square inch. This shear is in accordance with good practice.

The reasons for calculating the proportion in this manner, were derived from the following: After carefully examining the conditions, it was decided that as the pressure was applied the pin would gradually bend upwards, thus transferring the pressure to the edge of the link. This in turn would exert a tendency to bend the link in the direction of the arrow "A," as shown by the dotted lines in Fig. 1, this tendency being resisted: (1) By the resistance of the link itself to bending; 2. By the heavy strain upon the link, tending to keep it in a straight line. The links being bored to a neat working fit, the bending of the pins caused their seizure at the points "C" and "B" in Fig. 2. That such an action did actually take place, was shown by the fact that pins of presses, after having been in service for a year or more, were worn off as shown at points "E" and "D" in Fig. 3. After a careful consideration of the facts and conditions as above noted, a section was

[1]Alliance, Ohio.

laid out to a large scale, similar to that shown in Fig. 2. Upon inspection, the reason for the creeping of the pins became plainly evident. As the pressure was applied, the pin and also the link would bend, while at the same time the seizure of the pin would occur. Should the link be working tightly up against the face of the boss, which will be noticed surrounding the pin, this bending of the members would cause the link to bear against the boss heavily at "G", and this point acting as the fulcrum of a lever would pull the pin an infinitely small amount at each stroke. As shown by dotted line "H" in Fig. 2, the face of the boss was cut back only 1-32 inch to prevent the link from bearing at the point "G" and all trouble ceased. This problem has been used as an example of how an exceedingly small thing, easily overlooked, may be the cause of great trouble and expense, and when finally discovered, may be remedied with scarcely any effort.

SELECTING A FOREMAN

By Sterling H. Bunnell[1]

It is a difficult step which takes the progressive machinist from his position as one of a large number of fellow-workers of equal capability to that of foreman in charge of his previous associates. So much uncertainty attends the success of this step, both on the part of the manager and of the future foreman, that each must necessarily be interested in the viewpoint of the other. The employer can only judge by appearances, yet on his decison depends much of importance to himself, as well as the present success of the applicant in obtaining the position. Many a good man, having the temperament and ability to make a successful foreman, is prevented from taking his forward step from the ranks of the workmen by a lack of knowledge of how best to present his case.

The employer has first before him the question of promoting one of his own men, or of employing an outsider. The first is advisable only when the shop is already well managed, having been brought to a state of high efficiency by the previous good methods of good men. The competent outsider is the better choice for the many shops where methods are none too good or positively bad, and in any case there is much to be said in favor of the fresh experience of a man trained in a well-run shop in a competing line of business.

In selecting among the applicants, answers to advertisements by letter afford a fair opportunity of estimating the education and general ability of the foreman, by his handwriting and the subject matter of his letter. No letter, however, can serve as more than a sidelight on the character of the writer. It is evident that no progressive American can reach years of discretion and fail to absorb a good deal of general education, and while his handwriting will probably not be equal to that of a clerk, or his use of language equal to that of the recent high school graduate, his failure to profit by the opportunities afforded him must weigh heavily against the obviously clumsy writer and illiterate speaker, when measured with a view to his ability as a manager of men.

The experience of a man suitable for appointment as foreman should be practical, covering if possible more than the field of the shop in which he will work. He should by all means be a trained journeyman in his trade, able himself to perform all the operations which can fairly be required of a competent workman, but not necessarily able to equal his best men in their specialties. While there must be a first time for everything, an employer is wise, if selfish, in selecting from men who have had some actual experience as foremen.

The first step of the workman toward foremanship usually brings him to the position of gang boss or working foreman, where with the assistance of two or three other men not quite his equal in directing ability, he takes charge of and carries through important special assignments. Such training gives a man a good opening in which to try his head as a manager, while still depending on his hands to earn his living.

With regard to the appearance and dress of various men applying for such a position, the employer must judge shrewdly as to how far the ability to talk well may go, without becoming unnecessary volubility; how much self-confidence in ability may be desirable, without indicating disagreeable self-conceit; and how much age, with its attendant experience, is desirable, in preference to youth, with its greater capacity for action and greater flexibility of thought. Here again the magnitude of the position must be considered; a position as foreman in a small shop, at wages little better than those paid the best workman, cannot prove attractive except for a short time in a case of emergency, to a man capable of managing a large shop, so that the small shop must make its selection from a younger group of men, leaving the older and better paid men to the large shops, while the latter must avoid the employment of young men whose experience has not been such as to have brought them to the capacity required for the broad general oversight of a large department.

As for references from previous employers, these are always valuable, exactly in the way that the opinion of every man is worth listening to—but not necessarily worthy of every belief. It is true that men are by no means careful as to the statements to which they sign their names, and that they will praise their friends unduly, and abuse their enemies unfairly; or condemn their enemies by too faint praise, leaving the hearer to draw conclusions not in accordance with the words themselves. It is however worth remarking that every successful man has friends as well as enemies, and to weigh carefully the statements which each class of acquaintances makes with regard to him. A man without a friend to say a good word for him is one who should hardly be trusted. It is unusual to find anything but favorable comment made by men to whom an applicant for employment refers. It is interesting and valuable also to inquire of former employers regarding the applicant's principal faults, for all men have failings, and their work can be greatly improved by knowing and avoiding their weak points.

Finally, the applicant for a responsible position should consider carefully the probable frame of mind of the man who is to consider his application, and the impression he is going to make upon his prospective employer. With this in mind, dressed neatly and in accordance with his station, speaking with the confidence of his own ability and knowledge, avoiding the claiming of an impossible degree of skill and perfection, and above all confining himself to the strict truth as to dates, places and kinds of work he has done, he will stand an excellent chance of being number one in the final arrangement of the list of applicants, or of making such a close second that he will be recommended to some friend for the first similar position that turns up.

[1]Works manager, Griscom-Spencer Co., New York.

JAMES GAYLEY.

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GAS-ELECTRIC vs. STEAM EQUIPMENT FOR STEEL MILLS

A Study of the Question "Would It Pay to Discard Good Steam Equipment and Replace It With Gas-Electric Equipment"

By J. A. Knesche.[1]

Within the last few years a great deal has been written and said on the subject, "The most economical use of blast furnace gas." The subject is a large one and much remains yet to be said on it. When the question of a new installation for a group of furnaces is considered it is comparatively easy with all the necessary data at hand to compute the saving possible if gas blowing engines, together with a gas engine electrical central station using the surplus furnace gas, are to be installed. It is not difficult for one who knows furnace capacities and who is also familiar with blast furnace plants to figure the total power that may be generated with the available gas; nor is it difficult to figure the cost of this gas power, nor the power required to operate the furnaces, nor what power will be available for outside use under normal conditions. A great deal of excellent work has been done along these lines.

Would it Pay?

But to the writer's knowledge no attempt has been made to investigate the problem, "Would it pay to discard good steam equipment and put in its place gas-electric equipment," in the case of blast furnace plants constructed years ago; or if such attempts have been made few articles on the subject have appeared in the technical papers. One reason for this condition may be perhaps the fact that accurate knowledge of the conditions at the works for which the estimate is to be worked out is necessary before the question can be investigated as to whether it would pay, and what percentage of profit it would pay on the investment. It is usually thought by blast furnace men that, everything considered, it pays well enough in the case of a new blast furnace plant to use the surplus gas in gas engines if use can be found for the power generated therewith, but that it would not be a paying proposition to throw out good steam equipment that does its work very well, and to install in place of it gas engine equipment. This may or may not be true; there are so many things to be considered in gas engine installations for old blast furnace plants that the writer ventures the statement, that nobody is qualified to render an opinion on such a question without a thorough investigation beforehand.

The writer is thoroughly familiar with a number of metallurgical works and he desires to investigate and to discuss the question under what conditions it would be a paying proposition to throw out part of the present steam equipment and to install in place of it gas-electric equipment.

For this purpose there has been chosen a plant located on the banks of the Ohio river, consisting of blast furnaces, steel works, plate mills and pipe mills. The writer was always very optimistic about the possibilities of blast furnace gas and when the thought first came to him of looking into the most economical use of this source of power at the above-mentioned works he was sure that it would be a paying proposition to throw out the present steam equipment and to replace it with gas-electric equipment. After he had investigated the matter carefully for quite a long time he found to his astonishment at the close of his investigation that a change of equipment as mentioned before could not be considered as profitable an investment as he had anticipated at first. The cause, of course, was due to the conditions at the plant.

Usual Attitude of Executives with Regard to Changes.

Wherever a radical change is contemplated in a metallurgical works the first question that arises is, "How will it affect the output or tonnage?" If it can be established that the output or tonnage will not be affected by a contemplated change in equipment and that in the absence of other objections there will result an economy over the previous method of operation sufficiently large to warrant a change in equipment, then the contemplated change might be considered in order. But this fact must be established thoroughly in the mind of the manager before he will listen to any proposed change.

At the present time there is considerable skepticism existing among superintendents, blast furnace men and operating engineers in regard to the reliability of a gas-engine-electric central station using blast furnace gas. These men have usually much influence with those authorizing new equipment or changes in equipment. If this first-mentioned class of men could be convinced that their tonnage or output would not be reduced on account of the gas-engine-electric central station failing to generate, or in other words, if they could be convinced that such failures would not occur, then the change from one system to the other would be possible without arousing their opposition, for they too want to operate as economically as possible. But at the present time, delays in the operation of a metallurgical works mean much more to the manager, comparatively speaking, than any economy possible in the gneration of power.

The writer desires to emphasize this point and he repeats therefore that economies in the generation of power are considered highly desirable, but if the absolute certainty of continuous operation can not be assured, then, at the present time, it is thought to be cheaper to retain the old steam equipment. This is the view held by superintendents and mill men and as long as they can not be convinced that certainty of operation must result from an installation they will be very loath to recommend it. This is entirely just and reasonable from their point of view and "it is up to" the one advocating the change to bring proof that the output or tonnage will not be reduced by installing gas-electric equipment.

How the Difficulty Might Be Solved.

Now this proof may be established in the minds of the men responsible for tonnage by leaving the steam equipment in place as reserve and by installing motor drives. In nine-tenths of the cases in metallurgical works it will be possible to install these motor drives in such a manner that the old equipment may be used again if defects should develop in the gas-electric equipment, that might stop the operation of those departments depending on the said equip-

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ment for power. Clutches, temporary couplings, gears, rope, belt, and silent chain transmissions could be resorted to in order to bring this about. This method of installation could be used in practically all cases, for the motor takes up comparatively little floor space. Of course it might not be advisable to disturb the hydraulic equipment at the beginning, but in the case of the other machinery it would be possible to place motors in such a manner that, if necessary, power could be transmitted in a short time from either the motor or the engine.

Now if this can be done the one advocating the change has placed himself in a position where his new gas-electric installation may hope to get a trial. If in this trial (in reality not a trial, but considered so by mill men and superintendents at the present time) which may have to extend over several months in order to test the system under all possible conditions, the gas-electric power has proved as reliable as the former steam equipment, then the superintendents and mill men will offer no objections when the steam equipment is removed entirely; but it will have to remain until this proof has been firmly established in their minds.

Former Problem and How It was Modified.

The writer having all this certainty of continuous operation in mind, worked out the problem for the two blast furnaces mentioned before. As blast furnaces are sometimes subject to irregularities in their work it would not be safe to figure on both furnaces always being in operation. It is quite certain that one of the two furnaces is not in operation at times for some reason or other for a few hours, or for one or two days even, and in that case the gas engine electric central station could not operate to its full capacity. Therefore for a steady output of a certain power one furnace only could be counted upon, and the smaller one had to be taken as a matter of course, because it may happen that the larger one is out of blast for the time being. Thus it is apparent that the conditions of this plant made it necessary to carry 60 per cent reserve capacity and it is due to this fact that the profit on the investment required to equip this metallurgical plant with gas-electric power was not as large as the writer previous to his investigation hoped it would be.

This brings us now to the real problem. If several metallurgical works are so situated that they can combine their gas-electric power departments it will be possible to reduce the reserve furnace capacity to 25 per cent and the whole matter will assume a different aspect. For the case under consideration the reserve furnace capacity will be sufficient if taken at 25 per cent and the problem now is: We have the two blast furnaces mentioned; across the Ohio river from the plant under consideration is another metallurgical works consisting of two 225-gross-ton blast furnaces, steel works and plate mills. The distance between the two plants is not more than 2,000 feet. The two metallurgical works belong to different companies but both companies belong to one corporation. Assuming now that harmonious action could be brought about between the blast furnace departments of these two works, the question is, would it be paying investment to substitute gas power and gas-electric power for the present steam power in the two plants if the installations can be made so as to insure absolute reliable operation to both plants.

Requirements.

In this installation as worked out it is intended to equip the furnaces with gas blowing engines and to retain the present steam equipment in those departments as reserve units. The surplus gas is to be used in a gas-engine-electric central station and 75 per cent of the power that it is possible to generate from the fur nace gas of each works is to be used in these plants. Properly equipped brick buildings for housing all machinery are to be constructed, the necessary ground being available at convenient distances from the furnaces. An electric power transmission line is to be constructed between the two plants. Each metallurgical works is to be equipped with its own complete gas cleaning machinery and complete gas-engine-electric central station.

Since the two works are to pool their power generated from the blast furnace gas it is absolutely essential that there be harmonious action between the furnace departments of the two works. For the good of both, each furnace plant must always know what the other plant is doing or intends doing. It might even be necessary to have the furnace departments of both companies centralized and placed under the authority of one man. The two furnace departments would have to be so managed that temporary stoppages do not come together, that tapping be done in turn at the two furnaces, etc.

Methods of Accounting.

Against each gas-electric system must be charged the cost of operating the gas-electric central station. But this is not all. Ordinarily the first cost of the engine or motor and its cost of operation are charged against the department to which power is furnished. But no superintendent of any works would be willing to add the cost of electric equipment and its operating cost to his department when he already has a good reliable source of power which takes care of this work. His attitude will be, that if somebody wants to make an expensive experiment let him shoulder its cost. Thus the cost of the gas engine electric central station, the cost of the electric motor equipment, plus the cost of installation of the motor equipment in the mills and the different departments of the works will have to be charged against this new gas-electric proposition. The cost of operation of motors should be borne by the departments where the motor is used, because when the motor drives are in operation the engine drives would be idle. Now this arrangement will mean that the fixed charges of the electric motor equipment and those for the gas-electric equipment for the furnaces will have to be charged during this trial period against the gas engine electric central station. Therefore the profit resulting from the use of this system over the former steam equipment would be the difference between the cost of the same steam power and the operating cost of the gas-engine-electric central station, minus the fixed charges of the mill electric motor equipment, minus the fixed charges of the gas blowing engine installations. No value is assigned to the fuel because the same quantity of fuel is used in both cases.

Possible Devlopment of Power from These Four Blast Furnaces.

The average daily pig iron output of these four furnaces is 1,025 gross tons, requiring on an average 2,296,000 pounds of coke. This fuel used in the furnace will deliver through the downcomers about 156,128,000 cubic feet of blast furnace gas per 24 hours. A part of this gas is used for heating of the stoves, for which purpose various authorities give for American blast furnace practice percentages varying from 18 to 30 of the total gas produced. To be on the

side of safety we shall say that 30 per cent of the total gas delivered through the downcomers is required for the heating of the hot blast stoves, leaving 109,290,000 cubic feet, in round numbers, available for other purposes. Allowance must be made for an additional loss of about 5 per cent in piping before the gas reaches the engine cylinders, leaving about 104,000,000 cubic feet of gas available for conversion into power. The heat value of this blast furnace gas varies between 85 and 95 B. T. U. per cubic foot, and for the purpose of this calculation we shall assume an average value of 90 B. T. U. per cubic foot. The 104,000,000 cubic feet of gas per 24 hours represent therefore a heat value of 9,360,000,000 B. T. U., or 390,000,000 B. T. U. per hour.

Manufacturers and others interested in the sale of large gas engines claim the production of one brake horsepower-hour on 9,000 B. T. U. at full load and sometimes on even a little less. Since this no doubt represents ideal conditions, we shall assume a consumption of 12,000 B. T. U. for the production of one brake horsepower per hour, and at this rate there will be available for power purposes about 32,500 brake horsepower. Counting on a reserve capacity of 25 per cent, we have available for the two works in round numbers 24,000 brake horsepower. This power is to be divided between the two plants in proportion to their respective furnace capacities. These works will hereafter be designated as No. 1 plant and No. 2 plant and in accordance with the scheme of division suggested, No. 1 plant will receive 13,000 brake horsepower and No. 2 plant will receive 11,000 brake horsepower.

The details will be worked out for No. 1 plant only, which plant will require a more complex gas-electric system throughout than plant No. 2. The conclusions that will be reached finally are, however, applicable to both plants, because if, of the two metallurgical works under consideration having practically the same kind of steam equipment and using practically the same power, that one where all the conditions are most unfavorable when compared with the other can find it profitable to discard the former steam equipment and put a gas-electric equipment in its place, the other plant, where all the conditions are more favorable, will find it at least equally profitable to make similar changes in its equipment. All figures and details given hereafter will therefore have reference to No. 1 plant unless No. 2 plant is mentioned specifically.

Table I—Brake Horsepower Used at the Two Blast Furnaces of No. 1 Plant.

	Brake horsepower.
FURNACE NO. 1—	
2 blowing engines	1,150
1 skip hoist engine	150
Pumps	25
Electric lights	35
Blast furnace bells and miscellaneous purposes	50
FURNACE NO. 2—	
2 blowing engines	1,700
1 skip hoist engine	225
Pumps	35
Electric light	35
Ore bridge and transfer cars	200
Blast furnace bells and miscellaneous purposes	60
Total	3,655

or in round numbers, 3,700 brake horsepower.

Cleaning of Gas.

The cleaning of gas is now everywhere recognized as very important. The success of the entire installation will depend to no small extent on the degree of cleanness attained. In the last few years blast furnace men have found it desirable to clean the gas before it is used in the stoves and a considerable saving in gas or coke for the furnace and stoves is reported. In the proposed installation the gas in cleaning is first passed through three large dust catchers in series and through two Zschocke scrubbers, also in series. After passing through these cleaners the temperature of the gas is brought down to about 300 degrees Fahr. and the dust content reduced to about from 0.3 to 0.5 grain per cubic foot. At this period of the process the gas is clean enough for the stoves and the quantity required for them is sent thither, while the remaining gas is cleaned in Theisen machines or special centrifugal fans placed in series.

After leaving the cleaning machines the gas is passed through dryers where the contained moisture is removed, so that dry, cool and clean gas is finally delivered to the gas engines. Sometimes the blast furnace gas is cleaned entirely in mechanically driven machines, but since all the power that is saved in the cleaning process can be used in the mill the writer believes it to be more economical to use such methods of cleaning as will require no expenditure of power, even though the first cost of installation be somewhat higher.

Experience indicates that about 1.8 to 2 brake horsepower are required to clean 10,000 cubic feet of gas per hour in a Theisen machine if previously cleaned so as to contain about 0.5 grain per cubic foot and that two centrifugal fans placed in series accomplish about the same result as the Theisen machine. When cleaned thus the gas does not contain more than 0.010 to 0.015 grain of dust per cubic foot.

The 4,340,000 cubic feet of gas per hour previously mentioned is the total for the two plants under consideration; about 55 per cent of this figure or 2,380,000 cubic feet of gas per hour are to be cleaned by No. 1 plant. This will require an expenditure of about 476 brake horsepower, which power will be furnished by electric motors.

The writer recently had a conversation with Mr. Steinbart, the inventor of the Steinbart scrubber, and he claims that his scrubber will clean in one passage the blast furnace gas so as to contain not more than 0.5 grain per cubic foot with a consumption of water as low as three gallons per 1,000 cubic feet. The installation of such scrubbers would of course simplify matters a great deal, as it would do away with the extra dust catchers and the Zschocke scrubbers.

Excess of Power Available by Using Gas-Electric Equipment at No. 1 Plant.

In addition to the power required for the furnace machinery at the two blast furnaces of No. 1 plant there is now 1,000 brake horsepower additionally generated by steam engines that receive their steam from the furnace boiler plants where blast furnace gas is used as fuel. Table II shows the surplus power.

Table II—Power Available for Outside Purposes at No. 1 Plant.

	Brake horsepower required	Brake horsepower available by using gas-electric equipment.
Total power available if gas-electric equipment is used.		13,000
Power required for furnace machinery	3,700	
Power required for gas cleaning	476	
Extra steam power generated at present time by burning B. F. gas under boilers	1,000	5,175
Power available for outside purposes.		7,824

or in round numbers, 7,800 brake horsepower.

Distribution and Cost of Steam Power at No. 1 Plant.

The 7,800 brake horsepower would be distributed as follows:

	Brake horsepower.
Pipe mills	1,600
5 three-high plate mills	3,000
Present electric light and power	1,200
Blooming mill	2,000
Total	7,800

The average number of hours that the machinery in No. 1 plant is in operation is 7,200 per annum. The engines under consideration are simple, and as in all rolling mill work, the load on them varies between wide limits. The boiler houses are not equipped with any labor saving devices. Repeated tests have shown steam consumptions of 70 pounds of steam per indicated horsepower per hour for the blooming mill engine and plate mill engines. The average steam consumption per indicated horsepower per hour is between 45 and 50 pounds for the units under consideration.

B. H. Thwaite, who was among the first to foresee the use to which blast furnace gas might be put, says in *Iron and Coal Trades Review:* "The serious waste of fuel in the generation and transmission of power in even the most modern of iron and steel works is well understood, and the annual saving by substituting gas motors, driven with the blast furnace gas, for the present wasteful method may make all the difference in the balance sheets between profit and loss." While the question of economy in the generation and transmission of power has been considered a trifling one in the past and is still considered so by some metallurgical men of the old schools, the margin of profit in the steel industries though large, perhaps, is bound to grow smaller and smaller as competition in the world's markets increases, if due attention is not paid now to all questions considered trivial in the past.

Dr. Louis Bell in his book, "Electrical Transmission of Power," gives from 3 to 4 cents per horsepower-hour as the cost of power for simple engines for a 10-hour day under partial and intermittent load. These figures are for the total of fixed and operating charges. Judging from the cost data for the generation of power in several steel works with which the writer is familiar he feels certain that the cost per horsepower-hour in No. 1 plant is under no possible conditions less than 1.25 cents. He believes this is too conservative, but in order that he may be certain that any error which may occur is rather in favor of the present steam equipment the total cost per horsepower-hour has been taken thus. At this rate the total cost of 7,800 brake horsepower for the period mentioned represents an annual charge of $702,000.

Cost of Gas-Electric Equipment for the Blast Furnaces of No. 1 Plant.

Since with gas-electric installation no furnace gas is to be burned under boilers, it would be necessary to install gas blowing engines and electric motor equipment for furnace hoists, operation of bells, etc. Three gas blowing engines identical in every respect are to be installed in each blowing engine house that is to be constructed for housing the blowing engines, two for regular service and one as a reserve unit; also two complete electric compressor outfits with sufficient tank capacity to start all the engines without starting the compressors. All engines are to be fitted with electric barring-over devices. The following figures for the different items necessary for such an installation, based on a careful study of the requirements, manufacturers' estimates and computations, are thought to be very liberal.

Table III—Cost of Gas-Electric Equipment for the Two Blast Furnaces of No. 1 Plant.

2 blowing engine houses	$ 60,000
6 gas blowing engines	330,000
Foundations for same	24,000
2 traveling cranes	16,000
Gas engine piping	16,000
Air piping for blowing tubs	12,000
4 compressor installations	16,000
6 motors for furnace hoists and operation of bells	17,000
Total	$491,000

Cost of Gas-Electric Central Station for No. 1 Plant.

The total power output is to be 7,800 brake horsepower. Seven 1,500-brake-horsepower double-acting twin-tandem gas engines are to be installed driving direct-connected 1,000-kilowatt, 250-volt direct-current generators. When the gas engines operate at full load the generators would work under an overload of 12 per cent, which overload they can of course easily stand continuously. Two reserve units are to be installed in order to be certain that no shut-down or delay will occur because of an accident to a machine when one machine undergoes a cleaning. All the refinements known in gas-engine-electric central station practice are being used in order to make continuous operation absolutely certain. The cost of the different items of the gas-electric central station is given in Table IV.

Table IV—Estimated Cost of Gas Engine Electric Central Station, Inclusive of Installation of Machinery at No. 1 Plant.

Building housing seven gas engine dynamos, switchboard, etc.	$ 40,000
Seven double-acting, twin-tandem gas engines, 1,500 brake horsepower	380,000
Foundations for same	28,000
Seven dynamos, 1,000 kilowatts each, 250 volts, direct connected and complete electrical equipment for station.	200,000
One traveling crane	8,000
Two air compressor outfits	8,000
Total	$664,000

The gas engine electric central station is to be modern in every respect. The switches for the ignition systems for all the cylinders are to be separate for each machine and are to be placed on one panel within easy reach of the engineer in charge of the engine. The current for all the ignition systems of the entire station is to be furnished by a small motor generator having a storage battery in parallel. From here the current is to be taken to a separate panel from which it is to be distributed in armored conductors to each engine panel. Everything is to be arranged so that an accident to any one machine of any one ignition system will not affect the other units. The water supply for each machine is to be arranged in the same carefully planned manner; also the lubrication systems for the machines.

The writer is in favor of controling all these items from one centrally located point because this insures rapidity and certainty of operation, minimizes labor and does away with much excitement that usually accompanies accidents. Since this station will become one of the most important departments of the whole works, everything must be thought of in advance, such as lockers for men, wash room, store room, office for chief engineer, etc. With this forethought the station will be well designed and not a patchwork of afterthoughts. The amount set aside for this purpose is very liberal and sufficient to enable one acquainted with the needs of such a station to provide for them.

Cost of Gas Cleaning Machinery at No. 1 Plant.

All the gas is to pass through three dry dust catchers and then through two Zschocke scrubbers, all in series. After leaving the last Zschocke scrubber it would contain approximately between 0.3 and 0.5 grain of dust per cubic foot. The gas used for the stoves is now sent thither while the remaining quantity is sent to the gas cleaning plant. The Steinbart scrubbers could be installed instead of the arrangement just mentioned, but the latter has been figured on in computing the cost in order to be on the side of safety as regards first cost.

As mentioned already the furnaces at No. 1 plant are about one-half mile apart; the gas-engine-electric central station and the gas cleaning plant are to be located half way between the two furnaces. One dry dust catcher is already installed at each furnace; it

will therefore be necessary to install only two more. It is also thought more economical to install the two additional dust catchers and the two scrubbers at each furnace rather than to install them in a central cleaning plant because then the gas required for the stoves will not have to be brought back to the stoves in large and long mains, and further because at each furnace there is a depressed railroad track with side walls available over and upon which the dust catchers could be constructed. This is important as it reduces to a minimum the labor required to handle the dust.

Either Theisen gas cleaning machines or centrifugal fans are to be used to clean the gas to the degree required for satisfactory use in the engine cylinders. By satisfactory cleaning for engine use is meant reducing the dust contents to from 0.010 to 0.015 grain per cubic foot. When the dust content of the gas is brought down to this figure it should be possible to run from six to nine months before a thorough cleaning of the engine would become necessary. The writer saw recently a statement that when the dust content is from 0.04 to 0.05 grain per cubic foot only, it is usually necessary to give the entire engine a thorough cleaning every three or four weeks.

After the gas comes from the mechanically driven cleaners it passes through a drying apparatus to remove the moisture it contains. This of course is not absolutely necessary, but since it adds considerable time to the operating period between consecutive cleanings, such a drying apparatus will be installed. Table V gives the different items of first cost.

Table V—Estimated Cost of Gas Cleaning Machinery for No. 1 Plant.

Building	$ 6,000
Mechanical gas cleaning machinery, inclusive of foundation for same and motors	27,000
One traveling crane	6,000
5,000 feet of gas flues, placed in brick walled trench with cast iron covers.	50,000
1,000 feet of sewers	8,000
Dust catchers, scrubbers and dryers as mentioned	20,000
Additional water piping	5,000
Total	$122,000

Cost of Gas-Electric Motor Equipment at No. 1 Plant.

The steam power displaced in the pipe mills is 1,600 brake horsepower. This power is to be used in about 25 motors ranging in size from 5 to 150 brake horsepower. The majority of these motors are between 25 and 75 brake horsepower.

As already stated elsewhere, the present steam equipment is to be left in place temporarily and all motor installations are to be planned so that without too much loss of time the present steam equipment may be put into use again. This will, of course, make the installations much more costly than they would be if the steam equipment were taken out entirely, but for the reason already given no other method is possible. The writer has thought over the problem a long time and he has become convinced that it is possible to install motor drives thus. In the pipe mills standard motors may be used throughout and owing to the special requirements of the installation, the cost worked out to be $42,000.

In rolling mill work the requirements are very severe; the motors must be capable of taking care of large overloads lasting for a few seconds at a time; they deliver their power to mill driving shafts that are now coupled with engine shafts carrying 30-ton flywheels. Five motors, each with 600 brake horsepower normal output, would be required. There is sufficient space available at each plate mill, so that the electric motors could be placed properly and power transmitted by wire rope. The cost of this installation has been figured at $135,000.

The blooming mill is of the reversing type. The Ilgner system for electric reversing mill drives is to be used. This system requires the installation of a motor-generator set of 1,500-kilowatts capacity. The motor of the motor-generator or set receives its current from the gas-engine-electric central station. The armature of the generator of this set is in series with the armature of the mill driving motor. The speed and direction of rotation of the mill driving motor are controlled by adjusting the field of the generator of the motor generator set, the shaft of which carries also a heavy flywheel. There is sufficient space available in the blooming mill in question to make this installation possible. No change whatever would be necessary to apply power to the gear of the mill driving shaft. The cost of this installation, complete, has been figured at $180.000.

Instead of furnishing current from the gas-engine-electric central station to motors in the electric light plant, which would drive the dynamos, it is proposed to let the present electric light generating units stand idle and to furnish the electric current from the gas-engine-electric central station to the switchboard of the electric light station. In this manner no motors would be required to drive the generators of the electric light station and the principle of providing reserve units would be adhered to strictly. The electric light department would profit more than any other department, because its cost of operation would be reduced more than 75 per cent. Later, in all probability, the electric light station would be combined with the gas-engine-electric central station, because there would be little excuse for its separate existence. The cost for cables necessary to bring the current to the electric light switchboard has been taken at $2,000. Table VI gives the different items of motor equipment necessary for No. 1 plant.

Table VI—Cost of Motor Equipment Required to Take the Place of the 7,800 Brake Horsepower Steam Equipment Plus High Cost of Installation Necessitated by Reserve Conditions.

Cost of 1,600 brake horsepower motor equipment in pipe mills	$ 42,000
Cost of 3,000 brake horsepower motor equipment in plate mills	135,000
Cost of 2,000 brake horsepower motor equipment in blooming mill	180,000
Cost of necessary cables for present electric light and power station	2,000
Total	$359,000

Cost of Transmission Line Between No. 1 Plant and No. 2 Plant.

To guard against unnecessary shutdowns in either of the two works a transmission line between the plants will be necessary. Since the electric equipment in both plants is so designed as to make parallel operation possible and even necessary at all times, the electrical transmission line would form an important connecting link between the two plants. The line is to be designed so as to transmit 3,000 horsepower normally. The distance between the two plants is about 4,000 feet. Under the conditions given, it would not be practicable to install rotary converters, nor would it be advisable to throw the present 250-volt direct-connected equipment aside and install in its place alternating-current machinery. Since these installations and changes are not practicable, the cost of the power transmission line between the two plants is high, because of the great amount of copper needed and further because of the necessity of a very substantial construction of the towers. The total cost of this line has been estimated at $45,000, of which No. 1

plant contributes $25,000, while No. 2 plant contributes the remaining $20,000.

Resume of the Total Costs of New Installations Made Necessary by the Proposed Gas Electric Equipment of No. 1 Plant.

In Table VII is shown the total cost of installations of all the blast furnace gas, with the exception of that quantity used in the hot blast stoves, which is taken for the generation of power.

Table VII—Total Costs of Necessary Installations at No. 1 Plant.

Cost of gas electric equipment for blast furnaces	$ 491,000
Cost of gas engine electric central station	664,000
Cost of gas cleaning department	122,000
Cost of electric motor equipment	359,000
Cost of transmission line	25,000
Total	$1,661,000

Operating Cost of Gas-Engine-Electric Central Station.

The operating charges of the gas-electric central station are made up of the cost of water, of lubricants, wages and salaries, repairs in the entire equipment and the fixed charges. No value is placed on the gas because at the two plants in question the same quantity of this fuel is used whether or not the power is generated in gas engines.

The fixed charges are made up of the interest on the investment, of depreciation and maintenance expenses on the equipment, taxes and insurance. This item for the gas-engine-electric central station and gas cleaning department was arrived at after much computation and the examination of many data bearing on this question. It has been placed at 14 per cent of the investment, or about $110,000 per annum.

The water used for gas cleaning and for the gas engines is given by various authorities at from 10 to 16 gallons per brake horsepower-hour. Manufacturers often give much less than this, but practical men generally agree that while 10 gallons is very low, 16 gallons per brake horsepower-hour is sufficient for all cases. If we assume full load conditions, the cost of pumping at 1.5 cents per 1,000 gallons, and 16 gallons as the required amount per brake horsepower-hour, the cost of water per annum for the entire gas-engine-electric station would be about $15,000.

The cost of oil, grease and waste has been computed at 0.03 cent per brake horsepower-hour. For steam machinery this item is usually given at from 0.018 cent to 0.02 cent per brake horsepower hour but in the case at hand the cost of lubricants has been worked out on the basis given. At this rate the total amount to be set aside for 7,800 brake horsepower for 320 24-hour days would be, in round numbers, full-load conditions assumed, $17,900 per annum.

The gas-engine-electric central station would require the following personnel and salaries for its successful operation:

1 chief engineer	$ 5,000
1 assistant chief engineer	3,000
6 engineers at 30 cents per hour (three men for each 12-hour turn)	7,900
8 helpers at 22.5 cents per hour (four men on each 12-hour turn)	7,900
4 dynamo tenders at 22.5 cents per hour (two men on each 12-hour turn)	4,000
4 switchboard tenders at 20 cents per hour (two men on each 12-hour turn)	3,500
2 men for cleaning plant and compressors at 25 cents per hour (one man on each 12-hour turn)	2,200
Total per annum	$33,500

Before leaving the subject under discussion, the writer desires to say a word with regard to the personnel of the gas-engine-electric central station. After every precaution has been taken to make the department strictly first class and modern, the certainty of continuous operation will still depend largely on the power station personnel. A gas engine has to be managed differently from a steam engine, and few steam engineers possess at the present time sufficient knowledge of the more intricate gas engine to enable them to operate the latter without special drilling. A good steam engineer may, of course, learn to become a good gas engineer. The latter does not require greater mental abilities or capacities differing from the former. But at the present time there are few experienced gas engineers. The manufacture and operation of large gas engines is of comparatively recent origin, and knowledge in successful gas engine operation has not yet become very general.

In addition there are a great many other things that must be looked after carefully if a successful change is to be made from the present system to the one outlined. All these many details will require a chief engineer who is a good and energetic executive, who understands the theory of the gas engine thoroughly, who is strictly up to date in his special field, who keeps well informed of the progress that is being made continually and who is not afraid to do hard work himself if need be, and if nobody else on his force is able or knows how to do certain work. Much indeed will depend upon him, for he will have to create and teach his organization. He should be paid liberally.

In "maintenance and repairs" under "fixed charges," small repairs are included. These small repairs, adjustments, etc., would be made by the regular personnel of the station. However, a separate fund should be set aside to cover possible accidents from careless and unskilful operation, wear, etc. From large installations in operation it has been concluded that about 0.025 cent per brake horsepower-hour would be fully sufficient for such a fund, or in round numbers $15,000 per annum. Table VIII gives a resume of the operating cost.

Table VIII—Cost Per Annum of Operation of Gas-Engine-Electric Central Station in No. 1 Plant.

Fixed charges	$110,000
Water	15,000
Lubricants	17,900
Salaries and wages	33,500
Repairs	15,000
Total	$191,400

Fixed Charges on Mill Motor and Gas Blowing Engine Equipments.

As already stated under "Methods of Accounting," the fixed charges on the mill motor equipment and the gas-electric equipment for the blast furnaces must be charged against the gas-engine-electric central station. These charges are, however, to be made only, until proof has been furnished that the new installation is fully as reliable as is the present steam equipment. When this proof has been furnished, there will be no excuse for retaining the entire present steam machinery as reserve equipment and the only charge that should then be made against the gas-engine-electric central station is the cost of operating the latter.

The fixed charges for the mill motor equipment and the furnace installations necessary, have been computed at 14 per cent, which gives that equipment an average life of about 12 years. On this basis the fixed charges are as follows per annum:

Mill electric motor equipment	$ 50,260
Blast furnace gas-electric equipment	68,740
Total	$119,000

Balance Sheet.

We have now itemized all the outlays, expenses and savings possible and for the sake of clearness present them in a condensed form in Table IX. The "Trial Period" referred to is that period during which the steam equipment is used for reserve purposes and the "Confidence Period," that period when the reserve steam equipment is needed no longer. The pig iron production of the two fur-

naces at No. 1 plant is approximately 210,000 tons per annum.

Table IX—Outlays, Expenses and Possible Savings at No. 1 Plant.

TRIAL PERIOD—	
Cost of 7,800 brake horsepower for 7,200 hours per annum	$702,000
Operating cost of gas engine electric central station for same period	$193,400
Fixed charges on mill electric motor equipment	50,260
Fixed charges on gas-electric equipment for furnaces	68,740—$310,000
Net saving in cost of power thus generated	$394,600
Return on investment	23.3 per cent
Saving on cost in production of pig iron per gross ton	$1.86
CONFIDENCE PERIOD—	
Cost of 7,800 brake horsepower for 7,200 hours per annum generated with existing steam equipment	$702,000
Cost of operation of gas engine electric central station for same period	191,400
Net saving in cost of power thus generated	$513,600
Return on investment	30.7 per cent
Saving in cost in production of pig iron per gross ton	$2.43

Conclusion.

In this entire article the cost of the gas-electric equipment has always been taken at the upper limit and the lowest economical performances have always been chosen for all such equipment. This is not entirely just, of course, to the proposed change in power equipment, but it has been done because the writer realizes that it will require very strong proofs in order to overcome the skeptical attitude which is usually encountered when propositions such as those contained in this article are made. With careful design of all the details, it should be possible to reduce the first cost of the equipment from 20 to 25 per cent.

As has been shown, the costs of the various items of the entire gas-electric-equipment and the charges made against it are very high. This condition is due among other things to the fact that the first cost of such equipment is somewhat higher than the cost of the customary steam equipment usually found in metallurgical works. Further, the charges against the gas-engine-electric central station and the first cost of the entire proposition would be considerably lower if the present buildings could be used for housing the machinery. In the final accounting, after proof has been furnished that no steam reserve equipment is required beyond 200 or 300 horsepower in such an installation, the price realized from the sale of the old steam equipment, plus the value of the buildings now housing that equipment, should be deducted from the costs of the various items in Table VII. This has not been done in Table IX, because it is difficult to put a selling price on the old equipment and further because the value of the buildings housing the present steam equipment cannot very well be fixed before they are put to some other use, which, no doubt, would be done if they were vacant. As it is, there is no doubt that the entire matter is an excellent business proposition if harmonious action could be secured between the furnace departments of the two plants and if the necessary capital could be expended.

REPLACING OLD SHOP EQUIPMENT WITH MODERN MACHINES

A Discussion of the Conditions Governing Economical Production of Work in the Shop

By Joseph D. Morten.

As a general proposition the manufacturer operating a plant for the manufacture of machinery regards it advisable to use in his shop the most efficient designs of machines with a view to attaining the maximum output at the minimum cost. It is a difficult problem to select the proper machines to equip a new plant. It is also a problem with older shops to keep the equipment up-to-date without sacrificing some comparatively good machines by putting them on the second hand list or scrapping them altogether. There is a desire to keep the shop up to the minute and a wish that such and such a new machine might be bought, but the question involved in the mind of the shop owner is, "Will it pay?" The answer to this question requires careful thought and study of each individual situation and condition.

If the shop be an old one with a number of machines good in their time and machines which are "doing the work," the manufacturer may be losing money every day by not studying how much cheaper he could produce his work with newer machines.

The lathe is the most universally used machine in the shop and will serve as an example of how an improved new type lathe would prove a time saver and how one new type lathe might take the place of several old machines. Consider the increase in output possible with the later designs of lathes due to the more refined methods of obtaining speed and feed changes. There is, for instance, a certain feed and speed at which material can best be cut. The older machines have a rather coarse gradation in their speed and feed changes, which makes it impossible to run the tool at the most economical rate. Suppose a man is turning a job in an engine lathe of the old type, with a five-step cone pulley equipped with back gears. Assume that the job is such that the most economical speed for him to run the machine is one intermediate between the slowest speed and the next highest. The slowest speed possible on the machine is, say 20 revolutions per minute, the next highest speed might be 35 revolutions, while the proper speed for him to do the work would be 28 revolutions per minute. The same feature applies to the range of feeds on the older machines in that the operative is not able to find a point close to the speed and feed which he should use. The newer machines provide a much finer gradation of both feed and speed changes, and admit of the operators working very close to the proper requirements. In turning a piece on a lathe at a given number of revolutions per minute, the time, of course, is reduced at each cut, making the cutting speed slower with each passage of the tool over the work. The proper thing to do in this case is to speed up the lathe and this cannot always be done with the old style machine, because the next speed factor might be greater than the tool or the machine would stand. With a newer lathe, these changes can be made readily, resulting in time saving and a consequent saving in the cost of production.

An incident was recently given by a sales manager for a large lathe manufacturer relating to a case where two up-to-date lathes, specially adapted to the work to be done, had replaced 13 old type machines. The economy of such a replacement is too obvious to require comment. What is applicable to

lathes is equally pertinent in regard to other machine tools, including automatic machines for the production of small parts, gear cutting, etc.

It may be found, however, that in all instances it might not be an economy to discard fairly good machines and purchase of the newest types. The work to be done is the first consideration and the manufacturer must determine whether the new and improved type of machine would be particularly adapted to his product. An instance recently came up in going over a plant, in which it was found that an old machine was used in turning out a single job, where changes in speed and feed were not necessary. It was obvious in this case that the purchase of a high priced quick-change lathe was not called for.

Balancing the Shop.

One of the most perplexing problems in shop management and in the consideration of new installations is the question of balancing the shop. The installing of rapid producing automatic machines, of themselves highly effective, might over-produce the parts they were designed to make when the productive capacity of the remainder of the shop was considered. The machine might produce enough parts in two months to last the shop for the other 10 months in the year. It might be urged by the manufacturer that such a machine would not be an economy because it could not be driven to capacity—the shop having no use for the large number of parts that could be produced. Some manufacturers contend that such rapid producing machines are an economy if only employed part of the time, for the reason that the rapid production lowers the cost of the part to be made and even though the machine may be idle some of the time it is thus not being used and its life is thereby prolonged by saving of wear and tear. The governing principle in this case becomes the interest on the investment, floor space, insurance, etc. These factors are offset by the fact that some machine which will represent some investment, must be used for the work. The saving in time might fully justify the purchase and often does make it an economy to install the rapid machine. The cost sheet plays a part here and it may be found cheaper to have the parts made outside the shop.

It has been found by careful shop managers that they are carrying "drones" in the way of machines. An instance of this came to light recently in Cincinnati.

The shop was found to have a surplus of lathes and the management decided to dispose of some of these machines and with the proceeds from the sale of the second hand lathes to purchase machines adapted for certain other work in the shop. It was found upon investigation that the money could be best used in buying a drill grinder and a hand miller.

It developed in this instance that the shop had been making small parts on a large milling machine, while the work could be done with less breakage and more economy on a small hand miller. It was found that instead of grinding drills and other tools by hand the work could be done better and more rapidly with a drill and tool grinder. A boy under small pay could run the grinder, while an $18 per week machinist would grind the tools by hand and usually grind them wrong.

Aside from the economy of introducing up-to-date machinery and in keeping the shop "free from drones" the manufacturer of machine tools particularly, cannot well afford to advocate the introduction of new and up-to-date types of machines unless he, himself, employs the latest and best types in his shops. It would be an embarrassing proposition to have a prospective buyer inspect the manufacturer's shop and find out-of-date machines in use. While it may not be charged that manufacturers are careless in studying their equipment, the question is one which admits of closer attention than has been generally given to the subject.

The head of a manufacturing establishment, engrossed with the numerous problems which confront him, overlooks some features of the operation of his plant which call for correction, and a careful inquiry from time to time would undoubtedly result in the saving of the cost of manufacture. These problems have had more consideration since the depression in business, as the heads of concerns have had more time to devote to minute study of shop operation and added to this has been the development of new and effective machines as the pressure to fill orders for stock types of machines has been relieved, admitting of the bringing out of new designs.

Standard of Labor Increased by New Tools.

It has been found that the introduction of new and improved types of machines makes the operative more contented. Give the workman a good machine, and he will take more pleasure in his work. It has been found that where one lathe hand, we will say, has been given a new lathe, he will work better and steadier with it and that the next man, who may be running an old machine, would like to have the new machine, is not satisfied with his old slow speed lathe and will not work with the same energy that the man does who has the good lathe.

Danger of Extravagance.

The great progress that has been made in the development of machine tools has placed upon the market so many attractive machines and so many features of advantage in the way of attachments and time saving devices that the shop manager is constantly besieged by the desire to introduce one or more of these new machines. There must be caution against extravagance in this particular, but this caution should not be carried to the point where the shop may drop behind in the race by too close adherence to a policy of conservatism.

We, in this country, must not be unmindful of the necessity of maintaining a foreign demand for our products in machinery. With heavy transportation cost and other features of expense against us, we must not only produce machines of high efficiency, but we must make them at low enough cost to permit of their being exported. Our advantage has been gained in the past by progressive methods which have been too much for the conservatism of the foreigner. The foreigner is realizing this and is becoming more progressive. For this reason to maintain our position in foreign markets we must produce high quality and do it economically. Much time and attention is being given to the subject of education among the workmen. A high grade of labor is of distinct importance. The high grade workman, like the high grade machine, is an essential to this country. Our wage rate must not decline to meet foreign competition. If we are to continue to market our machinery abroad on a liberal scale, the question of shop management and the keeping up of shop equipment to the newest and most economical methods of manufacture is of vast importance. The question of installing new machines should be approached more in the receptive mood than in the spirit of resistance, but, as has been pointed out, careful study of individual circumstances is the first consideration. After being convinced of the economy of a change in method of manufacture there should be prompt action. Delay may beget a habit of drifting while progressive improvement and constant watchfulness would save the shop from dropping behind in the race or some day being compelled to re-equip at a heavy expense. By keeping the shop up, the saving in cost would begin with each new installation and the progressive spirit would be maintained.

THE ELECTRIC TRAVELING CRANE

A Discussion of the Conditions Governing the Design of this Most Useful Modern Appliance.

By Walter G. Stephan[1]

The electric crane business of today, like all other successful industries, is built upon a history which is filled with the records of many successes and many failures. It represents the work of many brains and of thousands of hands, and has called into service some of the ablest men in the engineering profession. While primarily a mechanical device, the practicability and extensive use of the overhead crane has dated from the time when the series-wound reversible motor was perfected. From that time on, the crane business has grown rapidly, until today it occupies a very enviable position in the business world. Previous to that time the use of hand cranes, belt-driven cranes, steam and hydraulic cranes represented the best crane practice. It seems incredible now even to imagine a traveling crane with a steam engine supported upon its girders for the driving power, and yet such was the fact. Many engineers today well remember the old-fashioned cranes which were driven by a square longitudinal shaft with drop bearings operated by a cam on the crane itself, and undoubtedly some of these cranes are still in use in old shops.

As previously stated, the great development of the electric overhead traveling crane has taken place since the perfection of the series reversible motor. Up to that time, while many engineers realized the great possibilities of electric driving for cranes, no motors were on the market which were suitable for the severe requirements of crane motors. As soon as the perfected motor appeared, designers applied themselves with great energy to new designs which included electric driving and the remarkable development since that time has resulted in a wonderfully useful and necessary tool—perhaps the most useful tool of any shop equipment. The growing needs of expanding business emphasized the necessity for a crane which could handle heavy as well as light material more quickly and more safely, and the crane builder has met

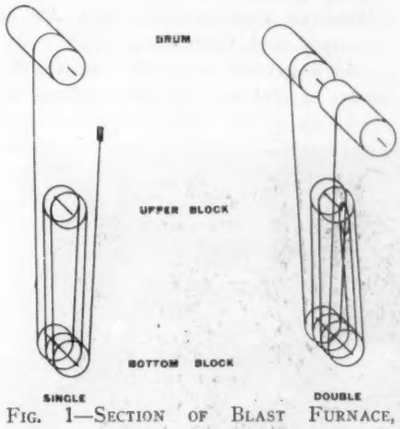

Fig. 1—Section of Blast Furnace, Showing Construction of Lining.

the demand very satisfactorily in the modern electric crane.

There are three primary motions which a crane must have. It must be designed to hoist the load, to shift it transversely and to move it longitudinally. Consequently the simplest, and also the commonest electric crane is the three-motor crane, which has a separate motor for each of the three motions. This is the crane which satisfies most ordinary conditions. However, the demands of special industries have developed a variety of cranes adapted only to those industries. Such cranes are, for instance, ladle cranes and bucket operating cranes. The application of electric driving to cranes has led to its use in various secondary ways for many operations which were not required previous to that time. It has also led to increasingly stringent demands from the crane purchaser which the crane builder has been more than willing to satisfy.

In designing a crane, local conditions may have considerable influence. The question of overhead and side clearance is important as well as the available traveling space. If the crane is to be operated out of doors, the operator and the mechanism should be properly protected from the weather. The presence of dust, dangerous gases, or heat will affect the location of the operator's cab and sometimes the arrangement of the machinery. The nature of the material to be handled must also be carefully considered as this may affect the design of some of the lesser details. Of course, the most important considerations are the loads to be lifted, the span of the crane and the speed of the various movements of hoisting, trolley travel and bridge travel.

The Three-Motor Crane.

There is not a great deal of difference in the arrangement of parts of the various standard three-motor electric cranes on the market today. All of the standard makes are very similar in general design, as can be seen from the accompanying illustrations. The standard crane is a so highly developed tool that the differences are

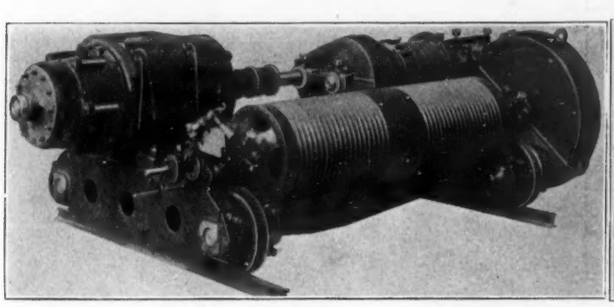

Fig. 2—Pawling & Harnischfeger Two Motor Crane Trolley.

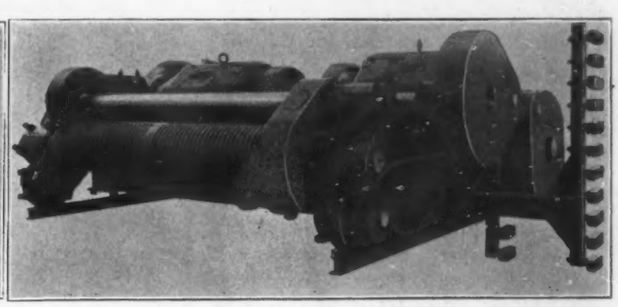

Fig. 3—Morgan Engineering Co. Crane Trolley, Showing Enclosed Gearing.

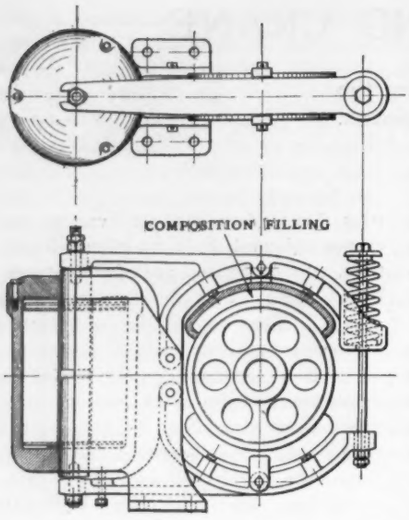

FIG. 4—SOLENOID BRAKES AS USED ON THE WHITING FOUNDRY EQUIPMENT CO.'S CRANES.

the shafting with its consequent troubles. This skew in the girders is moreover a constantly changing one, owing to the variableness of the track and this constant vibration, combined with the varying deflection of the girders, due to the hoisting of heavy loads, results probably in a binding in the bearings and an improper meshing of the gears. The use of stiffer girders for the bridge and of castings for trucks which hold the bearings securely in line, together with the use of enclosed gears to protect them and keep them better lubricated, are contributing much toward the increasing reliability and durability of present day cranes.

In this connection it will be interesting to note the differences between American crane practice and that of England and Germany.

As a general rule, the Germans are more careful as to details—perhaps too much so in many cases, although the fault is rather a good one since safety and durability are all important considerations. However, the statement is not intended to signify that German designs are safer than our own. In most cases the travel of the crane is over the heads of an army of workmen, whose lives must not be endangered unnecessarily, and this feature with regard to shop tools is being appreciated all the more today on account of the demand for legislation looking toward the protection of the employe. This fact will work to the benefit of the crane designer, as he need not resort to inferior materials in the manufacture of his crane.

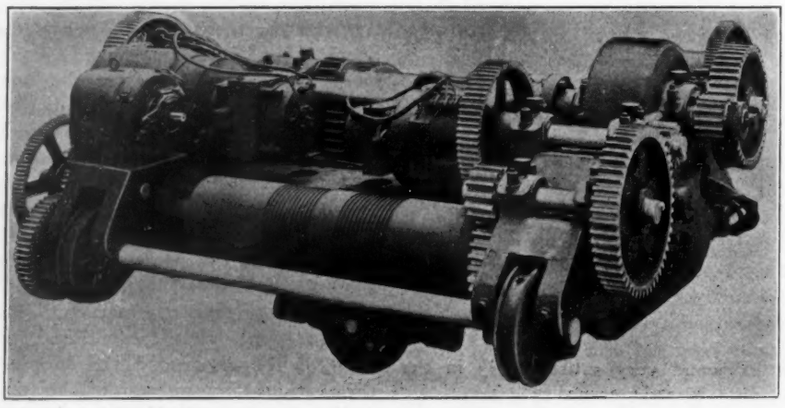

FIG. 5—WELLMAN-SEAVER-MORGAN CO. STANDARD CRANE TROLLEY WITH AUXILIARY HOIST.

mainly in the use of different kinds and grades of materials, as, for instance, the use of steel castings by some designers in place of structural shapes, or the use of bronze in place of babbitt metal for bearing surfaces. The general trend of development today is toward safer, more durable, more compact and still more accessible designs, with a continued improvement in the quality of the materials used.

Particular attention should be called to the fact that an overhead traveling crane is usually operated under very adverse circumstances resulting from its position on runways near the top of the building. These runways are often in rather poor alignment and out of level and the result is a necessary skew in the girders of the crane which results in a misalignment of

The Hoist Block.

The design of the hoist or bottom block depends upon the load to be lifted. The hook should be either a forging or a sound steel casting which has been carefully annealed—the former preferred. The nut on the hook should be locked and should rest upon ball bearings which allow the load to be turned freely and these in turn should rest on a forged trunnion which permits a free swinging of the hook in a vertical plane, both of these motions facilitating the hooking into a load. Wherever more than one sheave is necessary the load should be equally distributed on all the sheaves. The sheaves should be of large diameter, should be bronze bushed and well lubricated. The entire bottom block should be designed with a factor of safety of not less than six, and this factor should apply to all the rest of the crane as well.

In this connection it may be well to mention that cranes are not ordinarily provided with any device which will prevent overloading of the hook. For example, when the crane attendant may or may not be a man of good judgment, what is to tell him whether the casting which he is picking up weighs more or less than the 10 tons for which his crane is rated?

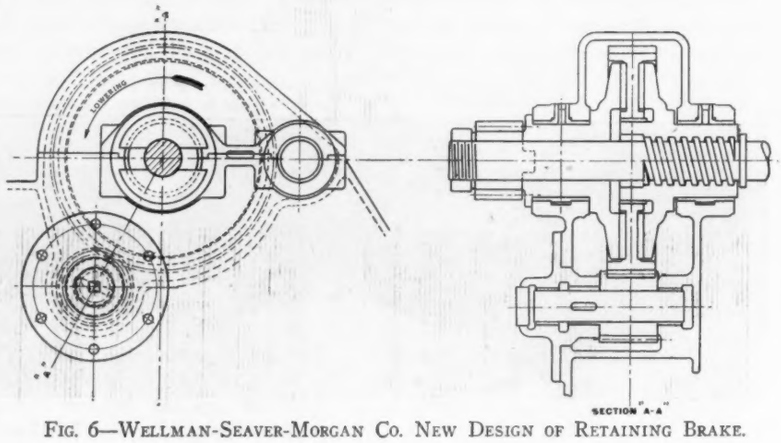

FIG. 6—WELLMAN-SEAVER-MORGAN CO. NEW DESIGN OF RETAINING BRAKE.

Nothing at all except his judgment or the straightening out of the hook. The result is that many a hook is loaded beyond its maximum rated capacity and is still in use only because of the large factor of safety. Does it not seem feasible that a device could be invented which would prevent these overloads? Of course there are various devices of this nature to be had, but all of them are such as require to be attached to the crane hook itself and consequently they take up much valuable head room, as well as increasing the number of parts involved. Possibly this device could be so made as to be able to weigh accurately all material lifted by the hook, which would be a most desirable point in a foundry, where it would eliminate the time and work of reweighing of castings which are ready for shipment, on separate scales.

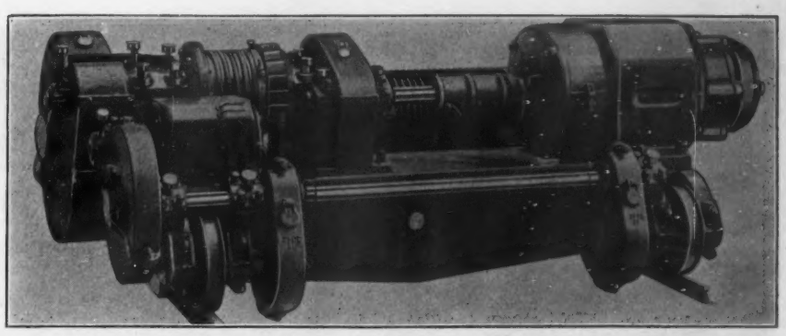

FIG. 7—PAWLING & HARNISCHFEGER TWO MOTOR CRANE TROLLEY SHOWING TROLLEY TRAVEL MECHANISM. THIS IS ANOTHER VIEW OF TROLLEY SHOWN IN FIG. 2.

Although German crane builders are using flat link chain for hoisting purposes and some American cranes are still being equipped with standard crane chain, the usual practice is to use a high quality of steel hoisting cable which is very flexible, much lighter in weight and cheaper than chains. Aside from its weight the use of flat linked chain is objectionable because it does not permit of a side pull except in one vertical plane, while wire cable can be swung out in any direction. Wherever standard crane chain is used for hoisting it should be carefully annealed before using, and it should also be reannealed periodically to restore its elasticity, and this also applies to the crane hook. Chains and cables should always be well cleaned and lubricated and nothing will contribute more to their long life than attention to these details. In England and Germany all crane chains are thoroughly proof tested for loads and stretch according to standard practice and faulty chains are rejected. American practice is perhaps not as rigid in this particular. A further reason for using cable instead of chain is the fact that a cable will give warning before it breaks, while a chain gives way all at once.

For wire cables almost universal application is made of the compound pulley block (see Fig. 1), and it is applied in double or single types, according

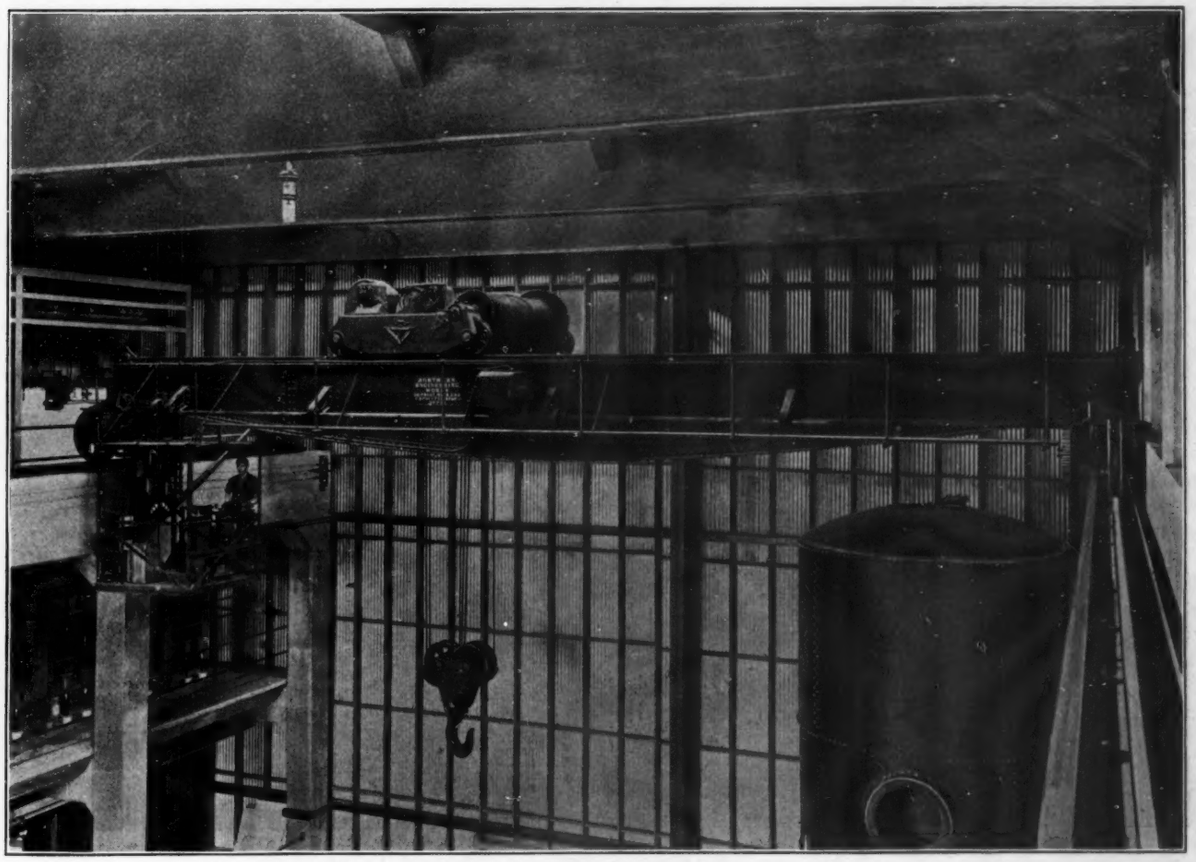

FIG. 8—NORTHERN ENGINEERING CO. STANDARD CRANE.

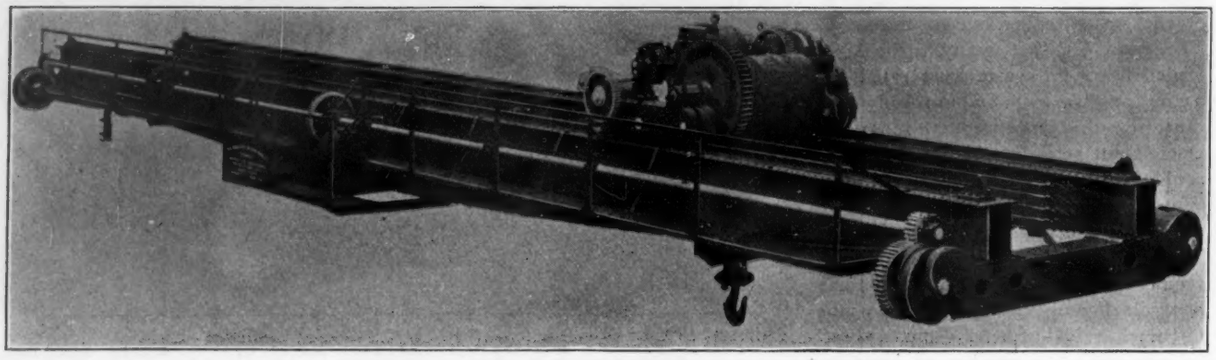

FIG. 9—WELLMAN-SEAVER-MORGAN STANDARD CRANE.

to conditions. The number of sheaves and parts of rope is dependent upon the load to be carried and in designing, careful attention must be paid to the lowest and highest desired positions of the hook. All cranes should be provided with a limit switch which cuts out the current from the hoist motor whenever the hook is raised to the highest allowable position. This limit switch is clearly shown in the trolley made by Pawling & Harnischfeger (Fig. 2). In this case, when the switch is thrown it is necessary for the operator to climb up to the trolley to throw it on again—the argument being that if he has to do this often, he will learn to be very careful thereafter. Several builders place the switch in the cab, so that he can throw it in at once, in order not to lose valuable time—claiming that the device as it is, is sufficient protection. The Alliance Machine Co. and the Wellman-Seaver-Morgan Co. equip their cranes in this way.

The Trolley.

The trolley is probably the most important of a crane because it contains the hoisting mechanism with its electric and safety brakes. Most crane builders use cast iron truck frames, which are tied together rigidly by either a cast iron or structural steel separator, which keeps the trolley wheels exactly in alignment. Figs. 2 and 3 illustrate two makes of trolleys of recent design. In looking over these designs one is impressed with the compactness of the machinery and yet all of the parts are easily accessible. The truck wheels are double flanged and of steel or cast iron with chilled tread and are supported between two bronzed bearings which allow the wheels and axles to be easily removed if necessary. All other bearings are cap bearings, so that any parts can be removed without disturbing the rest of the machinery. The hoisting drum is of cast iron with right and left spiral grooves cut from the solid metal and symmetrically placed so that the hook will always hoist vertically, and the load will be equally distributed on the two crane girders at all times. In no case should the drum be smaller in diameter than 30 times the diameter of the rope, and it should be of sufficient length to prevent overlapping of the rope. All gears should be steel and, except the drum gear and pinion, should have cut teeth of the very best workmanship to insure smooth working in hoisting, etc. All pinions should be forged steel. Many designers are making a special point of enclosing all of their gears in cases to exclude dust

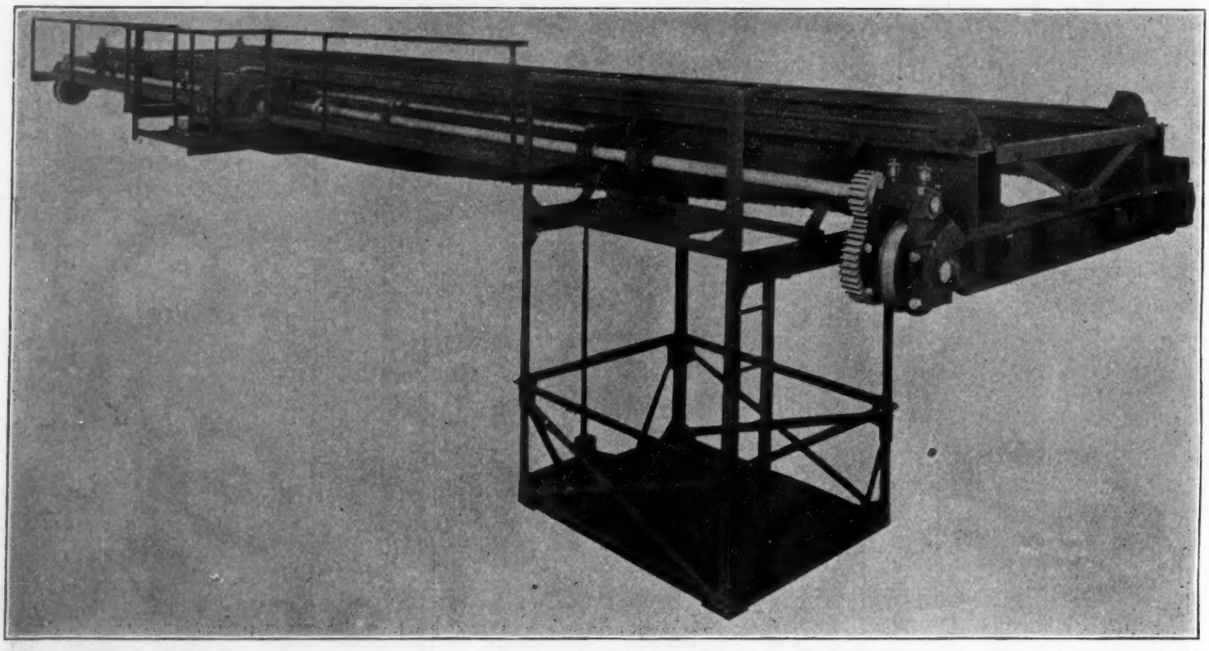

FIG. 10—MORGAN ENGINEERING CO. STANDARD CRANE.

FIG. 11—5-TON FLOOR OPERATED CRANE MADE BY THE CASE MANUFACTURING CO.

and grit and in most cases this is a very desirable feature. See Fig. 3. The Shepard crane, built by the Shepard Electric Crane & Hoist Co., is an entirely enclosed crane, the designers claiming that inasmuch as "cranes are necessarily located in unfavorable position for cleanliness or supervision by responsible persons, the design should therefore have special reference to these unfavorable conditions."

The drum gear is usually keyed to the hoist drum itself so as not to subject the shaft to torsional strain, and inasmuch as the gear is necessarily small in diameter and slow speed, the teeth of gear and pinion are usually shrouded and are steel castings. In Germany the practice obtains of driving the hoisting drum through a worm and worm wheel, but neither American nor English designers prefer this to double spur gearing. The advantages of the worm drive are the great reduction obtainable through them and the peculiar qualities which permit of holding a load easily in either direction.

The Hoist Brakes.

All modern cranes are equipped with two hoist brakes—one electric and one mechanical. The electric brake is either of the solenoid (Fig. 4) or magnetic friction type, both of which are so designed that they are set whenever the current in the hoist motor is cut out, and they are released when current again flows through the motor. Two different types of magnetic friction brakes are shown in Figs. 2 and 5—both being mounted directly upon the armature shaft of the hoist motor. These brakes

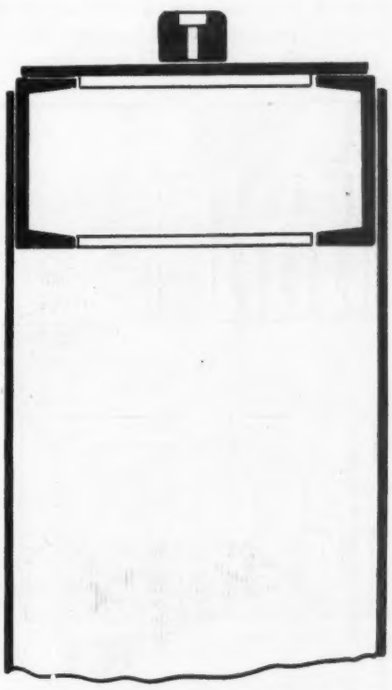

FIG. 12—SECTION OF TOP FLANGE OF GIRDER OF GERMAN CRANE, SHOWING USE OF FLAT BARS FOR RAILS.

are applied by a compression spring and the friction surfaces are of cast iron against brass, working in an oil bath, making the co-efficient of friction constant. The brake is released by an electro magnet. It should be capable of sustaining the full load of the crane independently.

The mechanical brake, however, is the important detail of every crane and it is variously called the "safety lowering," "load" or "retaining" brake. The object of all such brakes is to sustain the load at all times and to prevent the load from lowering faster than the speed of the motor;* and further to prevent the lowering of the load except when the motor is operated in the lowering direction.

In the load brake as used by Pawling & Harnischfeger (see Fig. 2), the frictional parts of the brake are locked and revolve together as one piece, but in lowering, one of these parts, supplied with a ratchet, is securely locked by two pawls and held from turning in that direction. The friction between these two parts creates the holding power of the brake so that on the film of oil between the two surfaces, that part of the brake attached to the brake shaft must slide only when assisted by the motor.

The retaining brake used by the Wellman-Seaver-Morgan Co. is shown in Fig. 6 and has recently been adopted by it in preference to the brake

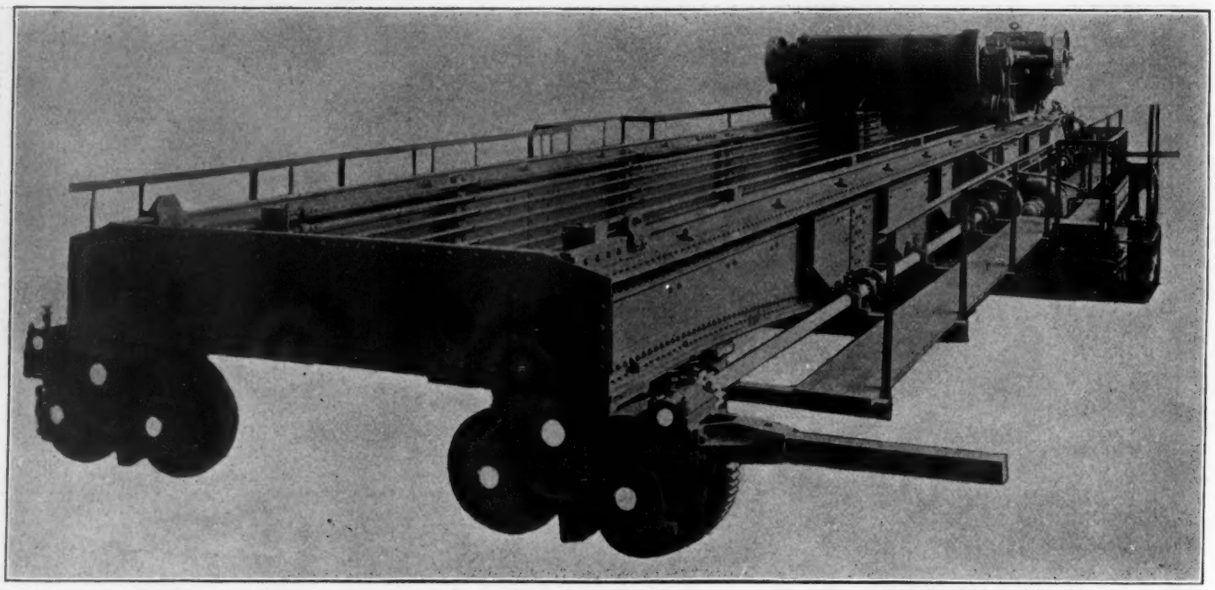

FIG. 13—MORGAN ENGINEERING CO. CRANE.

with fraction pawls formerly used, which they claim to be a constant source of trouble. While embracing no new principles, the brakes are designed with special reference to simplicity and accessibility. The brake proper is of the well known disc friction type, operating on a threaded shaft. The friction surfaces are bronze and steel, insuring long wear, as well as a constant coefficient of friction. These plates are automatically adjusted as they wear down. Friction pawls are replaced by a self-adjusting device which forms a positive stop in the lowering direction, but is free to revolve in the hoisting direction. The whole brake is enclosed in an oil-tight casing and all working parts operate in an oil bath.

The Auxiliary Hoist.

On heavy cranes, for hoisting light loads at high speeds, a secondary hoisting drum is provided geared to its own separate motor as illustrated in the trolley shown in Fig. 5. This hoist greatly facilitates the rapid handling of castings, etc., which vary greatly in size and weight.

The Trolley Travel.

Usually only two of the four wheels of the trolley are driven. The trolley motor is suitably mounted on the frame and two gear reductions are introduced between the motor and the axle. These gears, as in the case of all crane gears except the drum gear and pinion, should be of steel with machine-cut teeth. The trolley wheels are usually keyed to the driving axle which runs across the trolley, as shown in Fig. 3, and which in turn is driven by the motor through two trains of gears. Fig. 7 illustrates another arrangement of the trolley travel gearing, in which the intermediate shaft instead of the axle extends across between the truck frames, and drives two sets of gears, one for each axle.

The majority of German crane builders are favorable to the use of chain gearing on their cranes, while English makers are prejudiced against them. This mode of driving is seen very little in American crane designs and probably has no advantage except in special cases. Another point worth noting in connection with German crane design is the occasional use of roller bearings for their axle bearings. While this means a decided reduction in rotating friction, it also means larger axles and consequently more weight. A test of a 30-ton crane supplied with roller bearings is reported to have resulted in a tractive force of only 16 pounds per ton.

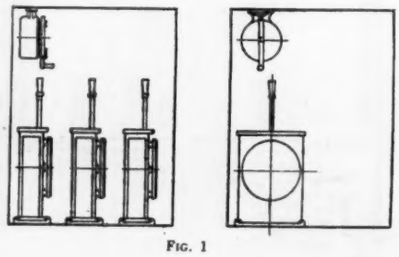

FIG. 1

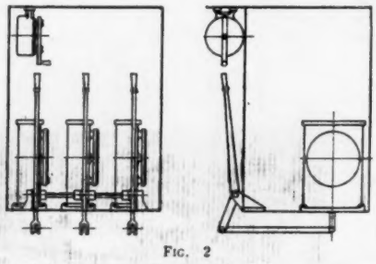

FIG. 2

FIG. 14—TWO ARRANGEMENTS OF CONTROLLERS IN OPERATOR'S CAB—ELECTRIC CONTROLLER & SUPPLY CO.

Usually the trolley motor is not supplied with a brake, this being unnecessary unless the speed of the trolley is high or some unusually severe service is required. The trolley motor, however, is sometimes provided with an electric brake which is like the one on the hoist motor and which may be fastened to the armature shaft on the outside, or may be included with the motor frame. This brake is off when current is flowing through the motor and sets immediately when the circuit is broken.

The Bridge.

Except for special cranes and cranes of short span and light loads, the bridge is made up of two plates, latticed, or box girders, usually the latter. Figs. 8, 9 and 10 illustrate the usual construction of the bridge girders, with the top flanges horizontal and the bottom flanges parabolic in outline. Sometimes on account of overhead clearance this order is reversed and the bottom flanges are horizontal, in which case the trolley

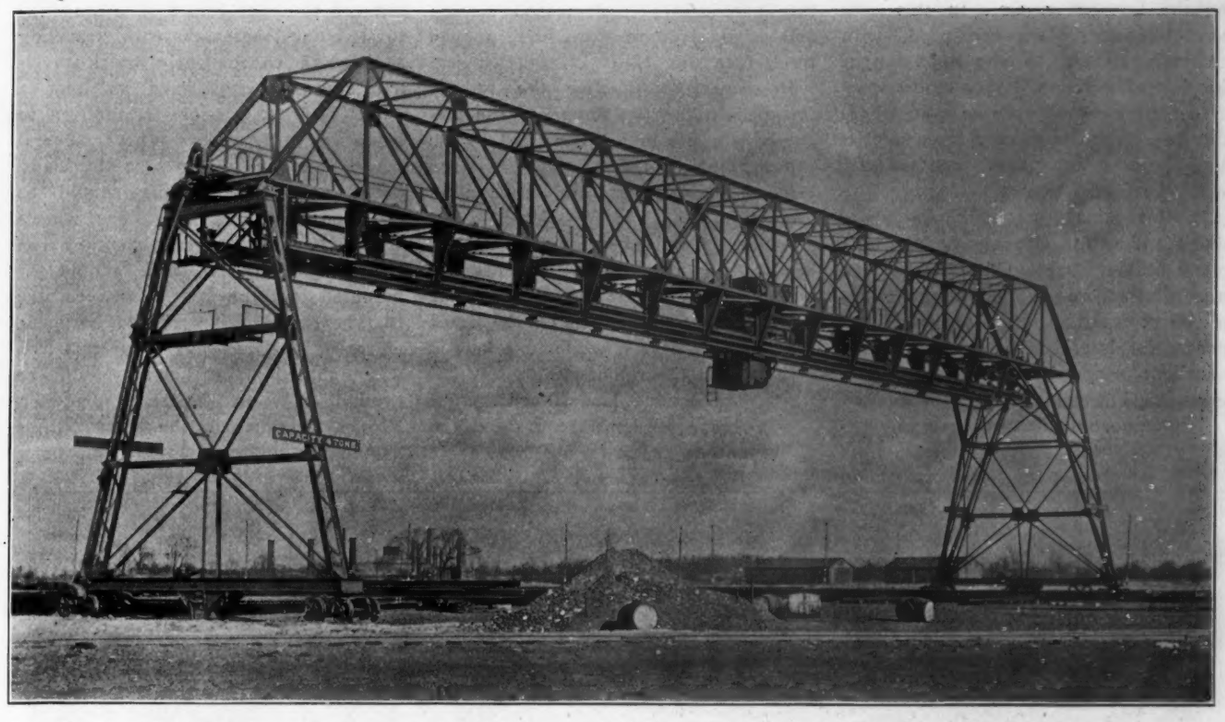

FIG. 15—FOUR-TON RAIL-HANDLING GANTRY CRANE BUILT BY THE WELLMAN-SEAVER-MORGAN CO. FOR THE NATIONAL TUBE CO., LORAIN, O.

travels on rails fastened on the inside of the girder close to the bottom flanges.

Again, the question whether full plate girders or latticed girders should be used is largely to be decided from practical experience. In very large spans the latticed girder is undoubtedly the most economical of material and where the crane is to be exposed to wind pressure the latticed girder may also have a preference. The depths of the girders varies from 1/10 to 1/20 of the span, according to the construction. Some builders favor the use of the two-plate girders of uniform depth for long spans, connected by bracing on the top of flanges, with the trolley traveling inside on the lower flanges as previously described. In cranes of short span and light loads, rolled sections are often employed, as shown in Fig. 11, which shows a five-ton floor-operated electric crane, made

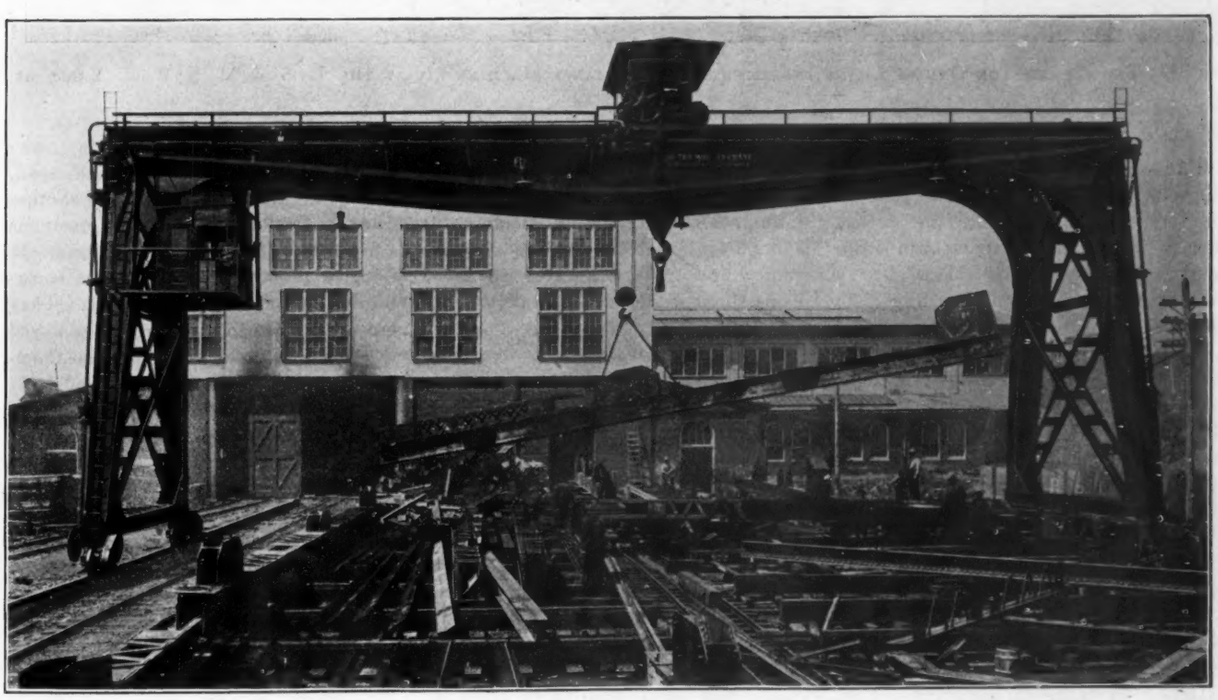

FIG. 16—FIFTY-TON GANTRY CRANE DESIGNED BY THE MORGAN ENGINEERING CO. FOR PENNSYLVANIA STEEL CO., HARRISBURG, PA.

by the Case Mfg. Co. In this case two I-beam girders are used, with channels riveted to the top flanges for lateral stiffness. Such floor operated cranes should only be used where the floor space is usually free, so that the operator can travel conveniently with the load.

In this same connection the writer would like to know whether any crane builders are making use of the new Bethlehem sections for cranes of short span. They provide eminently for lateral stiffeners and afford excellent space on long flanges for mechanical attachments.

The important feature in crane girder designs is ample strength and stiffness both vertically and laterally. Especial attention should be paid to the transverse strain on the bridge due to the sudden starting and stopping of heavy loads. The trolley tracks are usually laid centrally with the girders and on top of them, and should be held truly horizontal and parallel at all times. In American practice the standard T rail is used for the trolley tracks, but in Germany much use is made of a flat bar track with rounded edges on top, fastened to the center with bolts running through the top flanges. Possibly the German makers are able to secure flat bars of a high carbon steel which are suitable for this heavy service without rolling out flat. Another objection to the bar is the fact that it must be fastened by bolts through the center; this necessitates a decreased section and also a more or less uneven track (see Fig. 12).

In American practice the rail is fastened to the top flange of the girder by a series of rail clips and so the rail section is not decreased, nor is the top surface of the rail impaired in any way.

At either end of the trolley rail is provided a stop which prevents the trolley from overtraveling. In some cases the stop is bolted to the crane girder as in Fig. 9, while in others it is bolted to the rail itself.

The Bridge End Trucks.

The crane girders are fastened at either end to truck frames, which are either built up of structural frames or steel castings. The latter construction represents the best crane practice. It is important that the girders and end frames be rigidly connected so as to insure their being held parallel at all times.

Where cast steel frames are used the crane girder usually rests upon the top of the casting—the casting being planed to receive it, and is held in place by finished tight-fitting bolts and by steel wedges or chock plates (see Figs. 9 and 10). Where structural shapes are used the connection is a riveted one.

The wheel base should be as long as is practical and the usual practice is to make the ratio of wheel base to span about 1 to 6, although for long spans this ratio must necessarily be reduced to about 1 to 8. The tendency to twisting increases with traveling speed and consequently quick-traveling cranes should have as long a wheel base as possible in addition to being well braced. Where several wheels are required to take the loads, proper equalizing means should be provided (see Fig. 13). The wheels should be so mounted that they can be easily removed, and should be mounted on the axles between the two bearings. They should be made either of steel castings or of cast iron with chilled tread and should be ground truly to the same diameter. Proper clearance in the tread outline should be maintained, as well as a proper clearance in the crane span, so as to insure no binding. Sometimes the wheels are shrunk on their axles, but usually they are keyed. In German practice the wheels are sometimes run loose on their axles. They are then driven by toothed rings keyed or belted to the track wheels themselves.

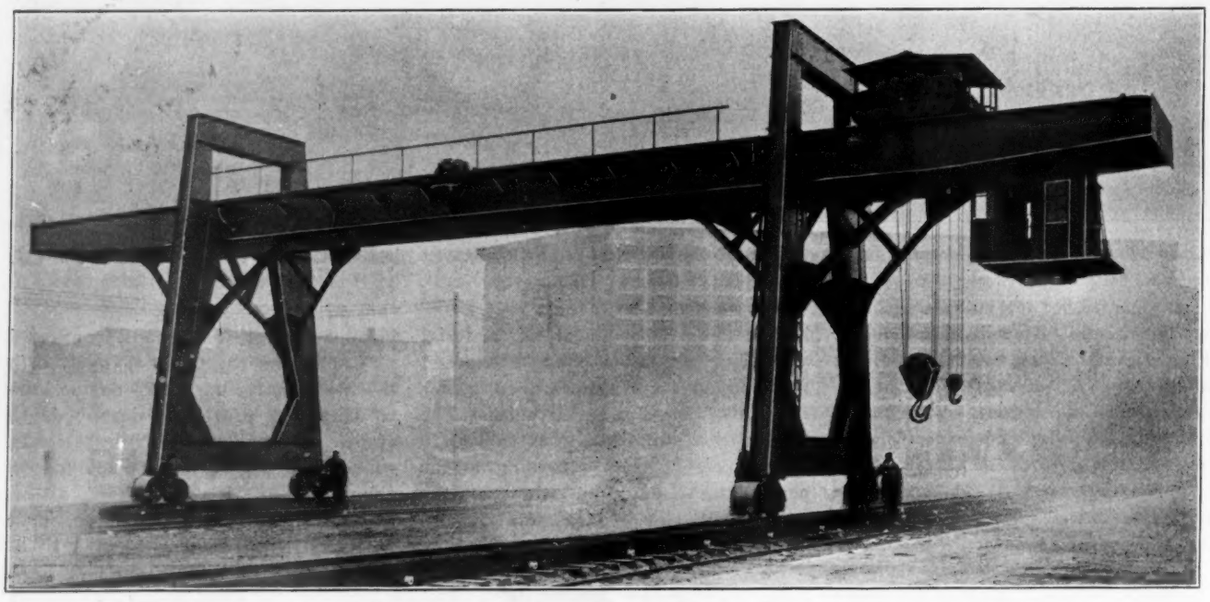

FIG. 17—TWENTY-FIVE-TON GANTRY CRANE INSTALLED BY THE ALLIANCE MACHINE CO. AT THE L. S. & M. S. R. R. YARDS AT TOLEDO, O.

The Bridge Travel.

The accepted practice for bridge travel mechanism is to mount a motor as near the center of the span as possible, on the outside face of one girder. Through a set of spur gearing at the center, the motor drives a long-coupled "squaring" shaft (see Fig. 8), which is supported on brackets at intervals along the girder. At either end of this intermediate shaft is a pinion which meshes with a gear on

either axle. It is important in this drive that the gears be machine cut and they should also be steel castings, except the pinions, which should be forged. Another important point is the location of the driving motor as near the center of the span as possible, so as to produce an equal torsional strain upon the long squaring shaft, thus insuring perfectly parallel driving of both ends of the crane at all times.

The bridge travel brake is usually a foot brake commonly placed on the squaring shaft for light cranes of five to 10 tons capacity, as near the center of the bridge as is practicable. Fig. 6 represents the usual practice of the best crane builders in locating the brake on the armature shaft of the motor for heavy cranes, thus insuring a brake that a man can operate easily, and also equal torsional strains upon the two sides of the squaring shaft when the brake is applied.

Only second to the hoist brake in importance, this longitudinal brake should be of sufficient power to stop the crane quickly when traveling at full speed with full load, and yet it must operate smoothly and not grip too sharply, especially on exposed cranes where hard frosts and the unequal surface of the rails may cause a severe twisting of the frame. It should act equally well in either direction and for this reason post brakes are used by the best crane builders.

Where the operator's cage is hung from the trolley, it is, of course, impossible to provide a mechanical foot brake, and in such cases magnetic brakes are employed for the longitudinal travel.

The Operator's Cab.

The operator's cab is ordinarily placed on the outside of the girder which supports the bridge driving shaft and at the extreme end of it. This position, as indicated in Fig. 10, permits of a maximum travel of the trolley and gives the operator the best view of his work. However, the cab is sometimes hung from the trolley, as previously mentioned, and again it is sometimes placed at the center of the span. Oftentimes the nature of the service determines the operator's position and fortunately the flexibility of electric circuits gives the crane designer great liberty in this regard. For instance, where the crane is required to handle hot metal, or where noxious gases are present, the cab is removed as far as possible from the work. Where the crane runway is high and the level of the work is near the floor, the cab is extended down to the working level.

The controllers for the various crane motors are usually placed upon the floor of the operator's cab, within easy reach of his hands. They should be so placed, wherever possible, that the movements of the controlling levers correspond with the resulting motions to the load. Sometimes it is desirable to leave the cab as free as possible and the controllers are then located in back of or above the cab and are connected by rods and bell cranks to the operator's levers. Such arrangements of levers are shown in Fig. 14, which illustrates a type of controller in very general use and made by the Electric Controller & Mfg. Co.

The wiring of electric cranes should demand special precautions; the wires should be so placed that, while protected from accidental touch, all connections should be visible and easily accessible for inspection. Each trolley wire end should have a wire-stretching device to keep it taut. All wiring should be easily traceable, so that in case of trouble each individual circuit can be readily followed. The marking or painting of wire terminals is sometimes employed to distinguish the circuits. The practice of using bars or angles for conductors along the bridge girders is constantly increasing, and is specified by the United States Steel Corporation. This construction is cheaper, stiffer and better than copper wire.

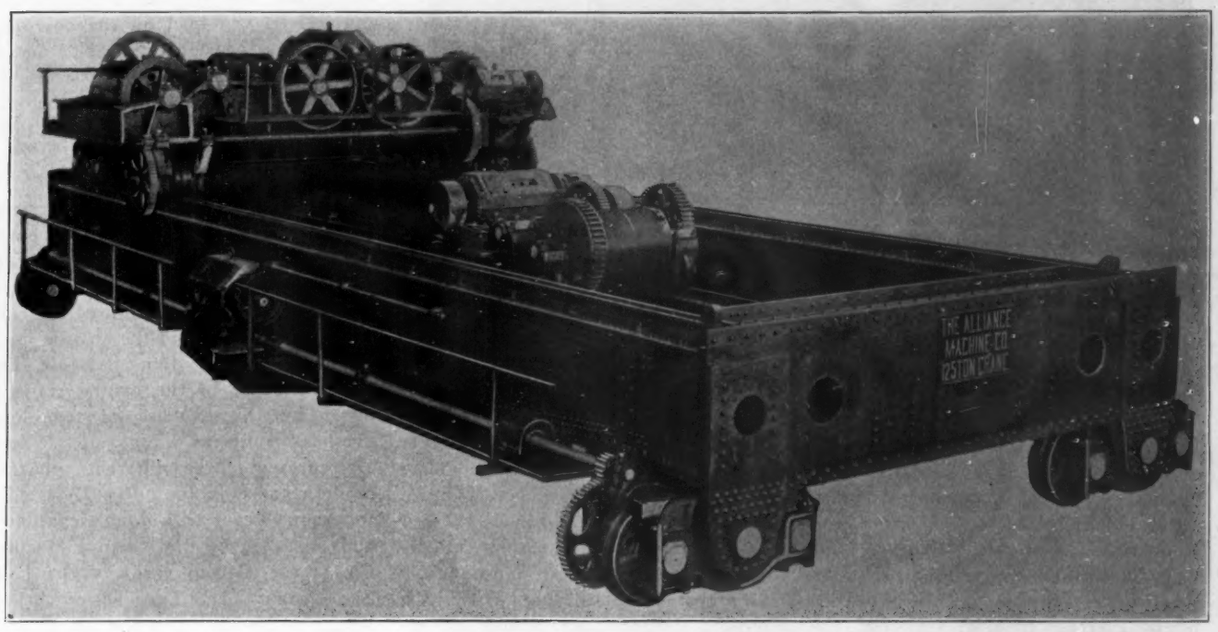

FIG. 18—LADLE CRANE BUILT BY THE ALLIANCE MACHINE CO. FOR THE DUQUESNE WORKS OF THE CARNEGIE STEEL CO.

Crane Motors.

The standard crane motors are almost invariably series-wound, direct-current types for 220 volts. Such motors are designed to run at constant speed with a constant load and will accelerate in a certain ratio with lighter loads. They are usually completely enclosed, so as to protect the commutator, etc., from the dust and grit which is usually present in shops and foundries. Crane motors are called upon for very severe service, such as sudden and frequent stopping

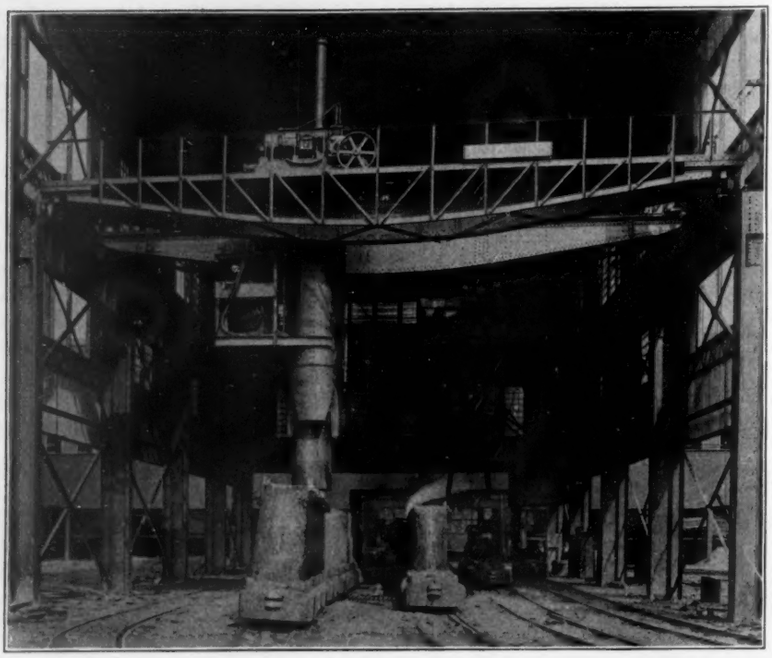

FIG. 19—100-TON INGOT STRIPPING CRANE BUILT BY THE MORGAN ENGINEERING CO. FOR THE BETHLEHEM STEEL CO.

and starting under heavy load, and variations in speed due to sudden changes in load. Owing to the special requirements of crane motors, some makers of cranes, like Pawling & Harnischfeger, manufacture their own motors, and these machines are thoroughly tested for their particular duty. Other crane builders are using the standard crane motors which are built by such well-known manufacturers as the Crocker-Wheeler Co., the Westinghouse Electric & Mfg. Co., and the Northern Electrical Mfg. Co., all of which concerns have devoted careful attention to their crane motor designs.

The determination of the horsepower of the motors required for the various crane motions is dependent upon what allowance the crane designer makes for friction of the moving parts. For instance, a well-known crane manufacturer allows 33 1/3 per cent for friction of parts in the determination of the hoist motor, which means that the motor used is at least one-third larger than would be required if friction were not considered.

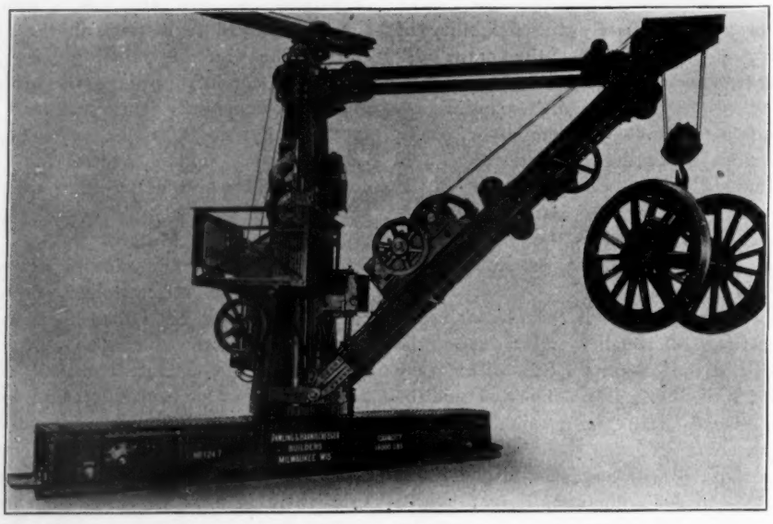

FIG. 20—SEVEN-TON WALKING JIB CRANE BUILT BY PAWLING & HARNISCHFEGER FOR THE CHICAGO & NORTHWESTERN RY. CO.

In bridge and trolley motions, 10 per cent of the total weight of crane or trolley, plus the maximum load, is figured for the journal friction. From this and the speed of travel the horsepower is determined and 33 1/3 per cent is again added to this latter for friction of gearing, shafting, etc.

The allowance for friction of bearings and gearing are dependent upon the materials used in construction and the workmanship employed. For bearing surfaces the best makers are now using phosphor-bronze and in some cases hard babbitt, although the latter is being used less than formerly. With proper lubrication such bearings will bring the friction between 0.10 and 0.15 of the load on the bearings. Involute cut gearing of superior manufacture should be employed wherever possible, in order to increase the efficiency and to insure smooth, uniform driving.

Gantry Cranes.

Electric overhead traveling cranes are used very much for yard purposes to handle stock, and are usually preferred by engineers to gantry cranes. However, where the length of the runway is very great and the span is long, a gantry crane is often advisable. The added expense of the gantry crane is offset by the expense of two long overhead runways. Figs. 15, 16 and 17 represent three different types of modern gantry crane. Fig. 17 is a 25-ton gantry crane with double cantilever ends installed by the Alliance Machine Co. at the Toledo yards of the Lake Shore railroad. The entire bridge length is 100 feet and the lift 25 feet. It is equipped with a five-ton, high-speed auxiliary hoist and is designed to cover four team tracks, three driveways and two railroad tracks, thus facilitating the handling of freight very materially.

Fig. 16 is a 50-ton gantry designed by the Morgan Engineering Co. for the Pennsylvania Steel Co. at Harrisburg, Pa. It is designed for handling structural material in the stock yard. It is of solid plate construction throughout, and the similarity of outline of the crane bridge to the bridge of the standard overhead crane is very striking. Liberal gusset plates at either end help to make a stiff connection between the bridge and the legs. The operator's cage in this crane is in a fixed position.

In the gantry shown in Fig. 15, we have a most interesting design by the Wellman-Seaver-Morgan Co., built for handling rails for the National Tube Co. at Lorain, O. It consists of a

bridge of latticed construction from which is suspended a runway for the main trolley. One end of the bridge is rigidly connected to a tower, while the near end is supported on hinged pin connections to a shear leg, so as to allow of a possible variation in the gage of the crane runways which is 179 feet center to center. The crane is carried on four four-wheel trucks, two of which are driven—one on each track—by gearing and shafting running up over the bridge. All the motions of the crane are controlled by one man in the operator's cab on the trolley.

The capacity of this gantry is four tons and the speed of hoist is 25 feet per minute, the trolley speed is 400 feet per minute and the bridge travel 350 feet per minute. Inasmuch as this crane is for operation out of doors, it is provided with rail clamps on tower and shear leg, which operate by means of solenoids and which grip the rails to prevent the crane moving along the runway when not in use.

Special Cranes.

There is such a great demand for cranes for special work that it will be impossible to more than mention a few of them here. One of the most important of these is the ladle crane, one type of which is shown in Fig. 18, which is a new patented ladle crane made by the Alliance Machine Co. This crane is one of six installed at the Duquesne works of the Carnegie Steel Co. The capacity of the main trolley is 125 tons, and of the auxiliary trolley 25 tons. The main trolley runs on the outer girders with the hoisting ropes hanging down between them. Separate inside girders support the auxiliary trolley and its ropes in turn hang between its girders so that the auxiliary can pass from end to end of the crane between the ropes of the main trolley and so tip the ladle hanging from the main hoist in either direction.

Another type of special crane which is rapidly finding favor is the ingot stripping crane which is shown in Fig. 19, and which was made by the Morgan Engineering Co. This crane is designed to strip the molds off the ingots in a steel plant. In this case the heavy duty required of the crane makes the girders deep and the motor sizes large. It has a capacity of 100 tons and was built for the Bethlehem Steel Co. Cranes similar to this one are designed for handling ingots from soaking pits, for charging furnaces, etc.

Interesting types of electric traveling cranes are shown in Figs. 20 and 21, the former being a seven-ton walking jib crane made by Pawling & Harnischfeger, and the latter a five-ton wall crane made by the Morgan Engineering Co.

The walking jib crane was built for the Chicago & Northwestern Railway Co. at its locomotive repair shops at West Chicago. It was designed to conform to requirements for operating in places that could not be reached with any other type of machine and performs work which was formerly done by hand. It travels upon a single rail flush with the floor and it is held in a vertical position by two guiding wheels, one running on each side of the stationary I-beam track fastened to the shop ceiling. The distinguishing features of this design are the adjustment of the main boom for varying heights and the auxiliary or extension boom. The latter can be extended for a hook radius of 23 feet by means of a hand power screw, driven by a pendant chain not shown. All the other movements of the crane are electrical.

Fig. 21 shows a very neatly designed wall crane, such as is used in shops to handle material locally and which travels on rails against the walls and underneath the electric overhead traveling cranes. These cranes are of light capacity and handle material rapidly.

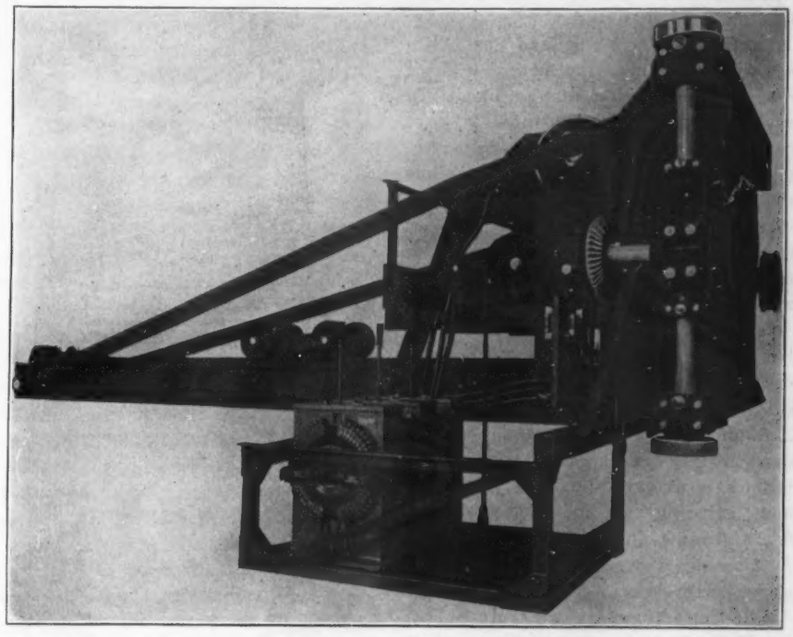

FIG. 21—WALL CRANE DESIGNED BY THE MORGAN ENGINEERING CO.

IDENTITY OF NEW OWNERS OF THE LAKE SUPERIOR CORPORATION.

Robert Fleming, of London and New York, is announced by Horatio G. Lloyd as the purchaser of the Lake Superior Corporation securities from Philadelphia institutions several weeks ago. Mr. Fleming represents English and Canadian capitalists, who, with Edward J. Berwind and associates, now fully control the Lake Superior Corporation. It is understood that the company will be re-financed, and that as a matter of course the new ownership will bring about a change of management.

In the four years ending June 30, 1908, the Lake Superior Corporation has accumulated a surplus of $499,182, and in the same period, the subsidiary companies have strengthened their working capital by retaining from earnings $922,386, a total accumulation of $1,421,568. In addition, the Lake Superior Corporation has paid the interest on its $10,000,000 first mortgage collateral trust bonds, and on Oct. 1, 1906, paid $150,000 interest on its income bonds, a total paid out in interest of $2,150,000. This, with the amount paid out, together with a surplus, makes a total of $3,571,508 to the credit of the plant for its operations.

THE SELECTION OF REFRACTORIES[1]

A Consideration of the Kind and Quality of Brick Best Suited for Various Parts of Different Furnaces.

The question of refractories is recognized by all iron and steel men to be of the utmost importance. Outside of raw material, fuel, labor and power it is probably the largest item entering into the cost of the product whether that product be pig iron from the blast furnace, refined iron, or steel in any form.

This article is intended to discuss, within its limits, and from the standpoint of the manufacturer of refractory materials, the different kinds of furnaces used in the manufacture and treatment of iron and steel.

"Refractory" is defined as "Resisting ordinary treatment; difficult of fusion, reduction or the like." In so far as the brick business is concerned, the word "refractories" relates to and includes all the materials that have been found useful for the manufacture of fire brick, or for use in other forms where the ability to resist excessive heat is required. In addition to being required to withstand heat, refractory materials are frequently subjected to one or more of the following conditions: 1. Chemical action of powerful fluxes and slags. 2. Reducing action of gases. 3. Sudden heating and cooling with wide temperature variations. 4. Pressure and grinding action. 5. Abrasion. 6. Cutting and impinging flame. 7. Combination of one or more of above, with heat.

The refractories in general use are 1. Fire clay (base kaolinite with a composition of $Al_2O_3+2Si\ O_2+2H_2O$) 2. Silica (ganister rock). 3. Magnesite. 4. Chrome ore.

Bauxite, carborundum, siloxicon and other substances have been proposed and in a few cases are in limited use for certain special types of furnaces. Bauxite especially, is valuable as a refractory under certain conditions and will probably come into greater use in the future.

Blast Furnace.

The modern manufacturing unit for the reduction of iron ore consists of one blast furnace and four stoves with the necessary piping and power plant. When we consider that furnaces are burdened with ores of such different character as Clinton hematites of the southern states, hard ores of Lake Superior, Mesaba soft ores, high sulphur ores of the Cornwall ore beds in Pennsylvania, limonite and so called mountain ores of Virginia and Tennessee, some of which contain appreciable quantities of zinc, magnetites of eastern Pennsylvania, New Jersey and New York, and hematite ores from Cuba, etc., it is easy to understand that conditions must vary greatly. These variations are intensified by further differences in the quality of fuels, design and operation of furnaces, grade of product and character of management.

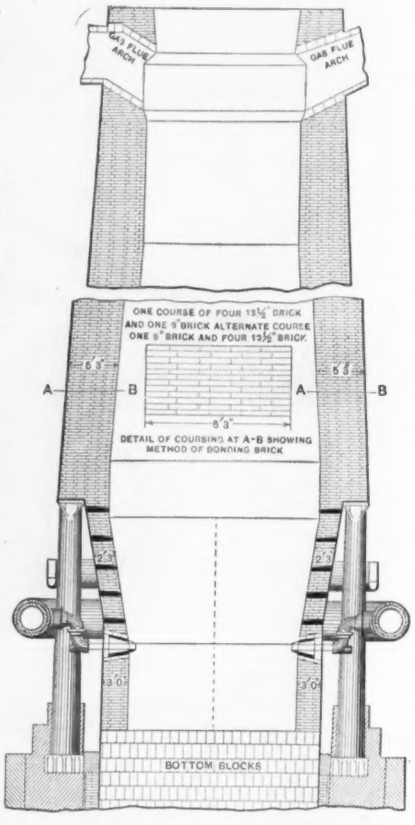
GAS FLUE ARCH
GAS FLUE ARCH
ONE COURSE OF FOUR 13½" BRICK AND ONE 9" BRICK ALTERNATE COURSE ONE 9" BRICK AND FOUR 13½" BRICK
A
B
A
B
DETAIL OF COURSING AT A-B SHOWING METHOD OF BONDING BRICK
BOTTOM BLOCKS

FIG. 1—SECTION OF BLAST FURNACE SHOWING CONSTRUCTION OF LINING.

A proper understanding of the conditions under which a furnace is operated being obtained, the selection of the brick becomes a matter of importance. All clays are not suitable for being made into brick for blast furnace linings. In some cases manufacturers of brick have a hard clay that could be used, but the bonding clay is not of the correct composition. Assuming a proper selection of raw clays, wide and varied experience in making blast furnace linings is necessary to a knowledge of how to mix and manipulate these clays so as to make brick which shall have the maximum resistance to the conditions in the furnace.

Among the chief causes which lead to wearing away the furnace linings, we may include:

1—The actual wear due to contact with the descending charge. This is relatively unimportant.

2—The action of alkalies, and of cyanides and other substances present in furnace gases. The effect of these is not yet accurately determined.[2]

3—The action of salt or other alkaline substances contained in the coke. By some authorities this is considered one of the most important causes of wear. At moderate temperatures salt is combined with silica and a fusible silicate is formed.

4—The flaking of bricks due to the deposition of carbon from carbon monoxide around iron particles reduced from impurities in the original brick.

5—The destructive action on the furnace wall caused by slips and scaffoldings tearing the brickwork away.

6—The channeling caused by the blast making its way up against the wall of the furnace instead of through the mass. This blast is charged with particles of coke, ore and limestone, and acts somewhat as sand blast in cutting out the brick.

7—Poor bricklaying and the use of inferior clay.

8—Too rapid heating of brick after re-lining. This steams the brick and injures the bond. Too rapid heating up sometimes causes the furnace walls to crack. If the furnace is forced before the carbonaceous coating has been deposited the lining is deprived of the indispensable protection of this coating and its destruction is some-

[1]From data compiled by the Harbison-Walker Refractories Co.

[2]A noted authority attaches much importance to the action of cyanides, stating that the reduction of the residual oxide of iron in the lowest region of the blast furnace is accomplished chiefly through the agency of cyanides formed near the tuyeres. The alkaline salts condense in the upper part of the furnace and are brought down to the level of the tuyeres as the materials descend; thus, each particle of alkaline metal does duty over and over again, the alkalies introduced in small quantities in the fuel accumulating in the furnace.

times only the question of a few months or weeks.

9—The actual wear due to the fall of ore, limestone and coke against the top walls of the furnace.

10—Irregular and faulty distribution. It is safe to say that this has been one of the prime evils that blast furnace managers have had to contend with for the past few years, due to the introduction of mechanical filling. Irregular or poor distribution is one of the most fruitful causes of failure of blast furnace linings.

11—Bringing the furnace up to capacity too soon after blowing in. Much prolonged discussion has taken place regarding the injurious effects of bringing up to capacity too quickly. The consensus of the best opinion is "If the furnace is brought up to full capacity in less than from six to eight weeks after the first iron is made, injury has probably been done to the lining."

12—Forcing the furnace. The pressure for output in recent years has unquestionably been responsible for some so-called failures of furnace linings. Pressure and volume of air have in some cases been pushed beyond all reasonable limits with consequent rapid deterioration of the lining and no corresponding advantage in tonnage or grade of output.

13—The destruction of the bond by the reducing action of carbonic oxide and other furnace gases at high temperature and pressure on the bonding impurities in the brick, whereby their physical structure is weakened and they are rendered friable. When the brick reach this state they are quickly worn away.

Selection of the Brick.

Several of the causes which contribute to the rapid destruction of blast furnace linings can be prevented to a considerable extent by the proper selection of the brick used in the lining. The varying conditions in blast furnace practice, with which the fire brick used in lining the furnace are so intimately connected, that it is apparent that to make brick best suited for these varying needs, demands intimate knowledge and careful study on the part of the manufacturer who aims to make blast furnace brick best suited to each particular case.

As a concrete case it is sufficient to refer to the fact that merchant furnaces varying their product to meet the market, are much harder on linings than furnaces running on the same grade of iron year in and year out.

It is important to remember that uniformity is a most important quality of brick used in blast furnace linings. All the brick used in the hearth and bosh, inwall and top, should be of uniform mix, grind and burn for their respective places in the furnace.

The necessity of using a considerable proportion of calcined clay is evident to the brick manufacturer whose object it is to make a blast furnace lining of the highest quality. Brick made of all raw clay contain from 10 to 14 per cent of combined water which is only driven out at a red heat in the kilns. The driving out of this water causes shrinkage and develops internal stresses and distortion. The use of calcined clay diminishes the amount of combined water to be expelled with obvious advantages to the brick.

Hearth and Bosh Brick.

If hearth and bosh brick are burned at high kiln temperatures and are all burned in the same position in a large number of kilns, it will insure their being better for the lining of blast furnaces than if they are burned and shipped "run of kiln." It is of course more expensive to burn brick at a high temperature than at a low temperature but the added expense adds qualities to the brick that are essential in blast furnace linings. It develops and utilizes to the highest extent the bonding qualities of the clay, brings out the small amount of iron present as an impurity and combines it with silica in the brick as a silicate of iron, and renders the brick tough, dense and hard so that they resist disintegration by the reducing action of the blast furnace gases at high temperature and pressure. It is of course essential that brick for the hearth and bosh be of the highest possible refractoriness.

Inwall Brick.

The lining in the inwall is not protected much above the bosh line by cooling plates, except in some few cases where they have been run well up in the furnace. The wearing away of linings is most pronounced in the inwall above the bosh. Brick for the inwall should be exceedingly hard, dense and refractory. As compared with hearth and bosh brick they can be slightly less refractory. This insures an increase in their hardness and density, when burned hard.

Top Brick.

The top brick must be hard; harder than those for hearth, bosh and inwall. They must also be tough and of the greatest possible density.

Laying Brick.

After having procured a good lining it is necessary to put it in the furnace properly. This requires constant and uniform care on the part of someone in authority. Clay of the same grade as the brick should be used in laying them and not more than 300 to 350 pounds to 1,000 nine-inch equivalent brick. Tempering the fire clay with steam adds to its plasticity.

All brick intended for use in a blast furnace should be kept dry, and especially they should not be frozen. All fire clay brick absorb moisture and if they are subjected to freezing temperatures the bond is weakened or destroyed.

The upward expansion of the lining in a modern 80 or 85 foot furnace may be set down at from 3 to 4 inches.

Bottom blocks should be set up and trimmed if necessary to make knife edge joints. Rectangular bottom blocks 18 x 12 x 8 inches have largely taken the place of cone bottom blocks which were used for a great many years. The rectangular blocks are very dense, true, easily laid and require very little chipping or cutting.

Especial care should be taken that the brick in the crucible of the furnace around the tuyeres and cooler plates are carefully laid with very close joints. The proper proportion of shapes, such as arch, wedge, split, etc., should be used instead of cutting straight brick to make these shapes. Throughout the furnace the utmost care should be taken in laying brick with close joints.

In laying brick in the crucible of the furnace it is customary at some plants to use pine strips ¾ inch to 1 inch wide. These are placed between the brick work and shell about 18 inches apart. In some cases brick are laid up practically tight to the shell and slushed in with fire clay. The use of pine strips is probably the better practice.

Piping Brick.

The matter of brick for piping is a most important one and in recent years the most progressive manufacturers have made brick of a special mixture for lining the various connections of the furnace and stoves. Many furnaces have had disappointing results from using for piping brick that were not suited for the purpose. These were either bought because they were cheap, or for the reason

that the furnace manager did not pay so much attention to the brick for piping as to the brick for furnace linings.

Brick manufacturers have had the matter of piping brick brought to their attention very forcibly in recent years and the necessity of understanding the conditions prevailing in the piping of the furnace and of meeting these conditions by proper variations of the mix, grind and burn of their clays, is known thoroughly, by the most progressive among them. It is necessary to remember that conditions in the hot and cold sides of the stove are different and brick should be varied accordingly.

The ease also with which repairs are made to brick work around hot blast valves, etc., compared with brick repairs in blast furnace and stoves proper, has no doubt prevented blast furnace managers from giving as much attention to brick for this purpose as seems desirable. There is no doubt but that unnecessary expense has been incurred through the use of unsuitable brick, which could have been saved by a knowledge and recognition of the fact that brick of quality entirely suitable for these places are now being made by some manufacturers who have at all times made it part of their policy to keep informed on the conditions prevailing in the different parts of the furnaces to which they supply brick.

Cooler Arches.

Over 90 per cent of the furnaces in the United States use standard shapes over the cooler arches or cut brick to fit.

Inwall.

In laying brick in the inwall it is customary to leave from 3 to 6 inches of space between the shell and brick work. This space is filled with mineral wool, granulated slag or loam. Mineral wool is considered to be the best possible material as it is elastic, non-conducting and does not pack. When granulated slag is used it is mixed with about 25 per cent of loam. Many furnaces use loam or broken bats for filling.

Top Brick.

Some furnace managers prefer blocks in the top of the furnace instead of the usual 9-inch and 13½-inch sizes. There is a difference of opinion as to the advantage of block linings over 9-inch and 13½-inch linings.

Blast Furnace Stoves.

The manufacture of brick for blast furnace stoves presents difficulties equally as great but different from those belonging to the manufacture of brick for furnace linings. The destructive action of the gases on the bond of the brick, the variation in temperature many times in 24 hours, the grinding and pressure due to internal movement, combined with the heat generated by the combustion of enormous volumes of furnace gases, create very severe conditions.

The essential qualities in blast furnace stove brick are capacity to absorb heat readily from the combustion of the waste furnace gas and readiness to give off this heat readily to the air that is forced into the stoves.

The quality of the clay, the mix and the method of manufacture must be such that the bond between the particles will resist the disintegrating action of the blast furnace gas and

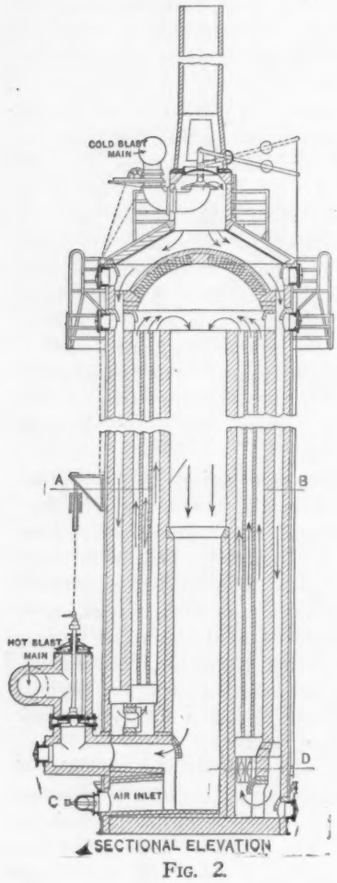

FIG. 2.

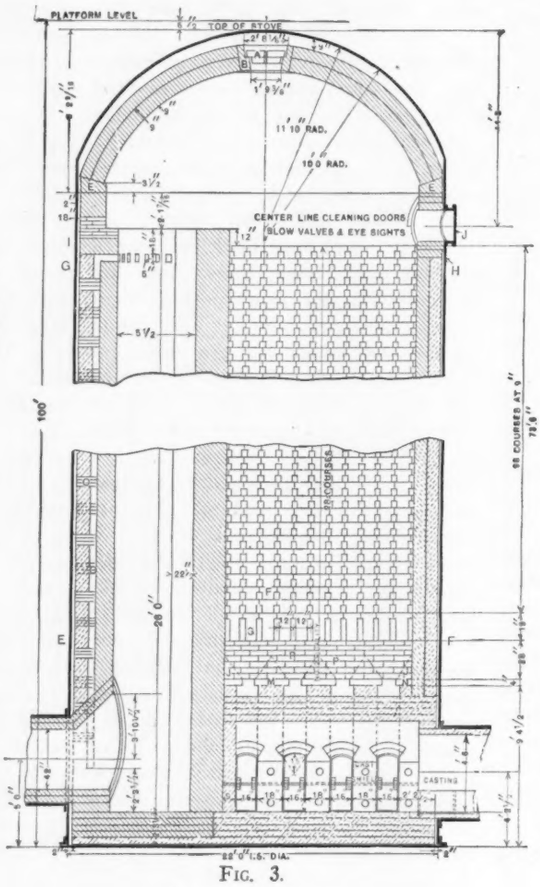

FIG. 3.

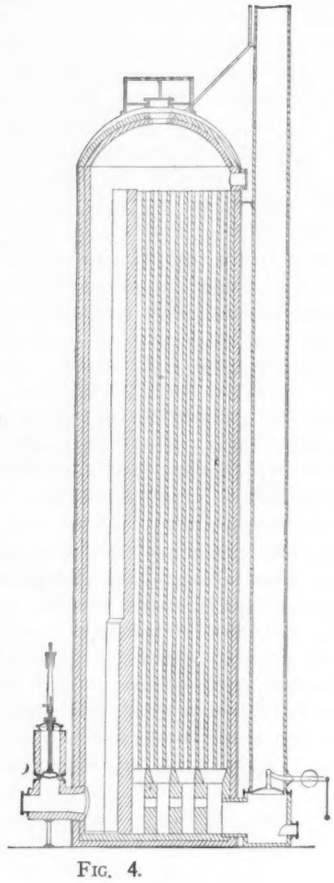

FIG. 4.

TYPES OF STOVES.

maintain the strength of the brick under the weight of the superimposed brick work. It is also necessary that they have a large margin of refractoriness to withstand the prolonged service expected. This is very important for the reason that as the dust collects in the flues and on the dome the heat absorptive and radiating capacity of the brick work is very materially decreased, and a furnace man may find it necessary to push the stoves. This dust is quite stove rusts out and this grouting of cement prevents the escape of the gases from the lower part of the stove.

In a stove 100 feet high the brick will rise several inches. Allowance should therefore be made for expansion. There is unquestionably a tendency to insist upon higher quality in both No. 1 and No. 2 quality stove brick. Modern conditions have made this necessary, and there are few blast furnace managers who do not realize greatest possible difference between clays of one district compared with those of another, in their behavior under the conditions and heat in stoves; and to use first quality stove brick from one district and second quality stove brick from another, may result in serious consequences.

The brick work in a well-designed stove should last for a good many years. Of course during this time the combustion chamber will be renewed several times and also the

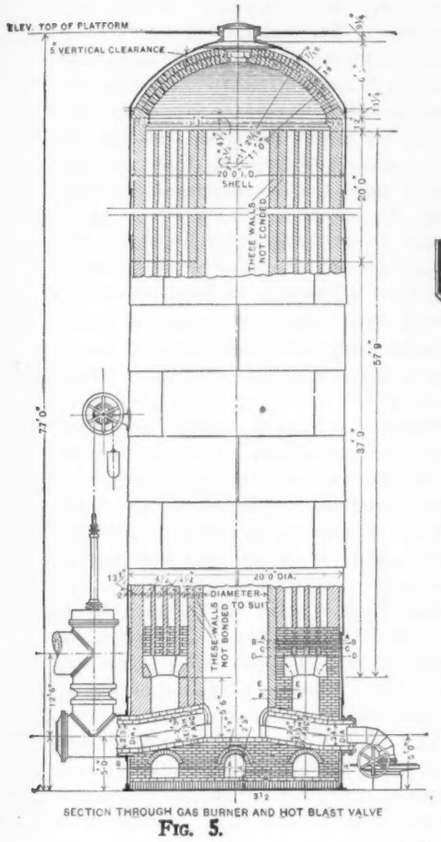

FIG. 5.

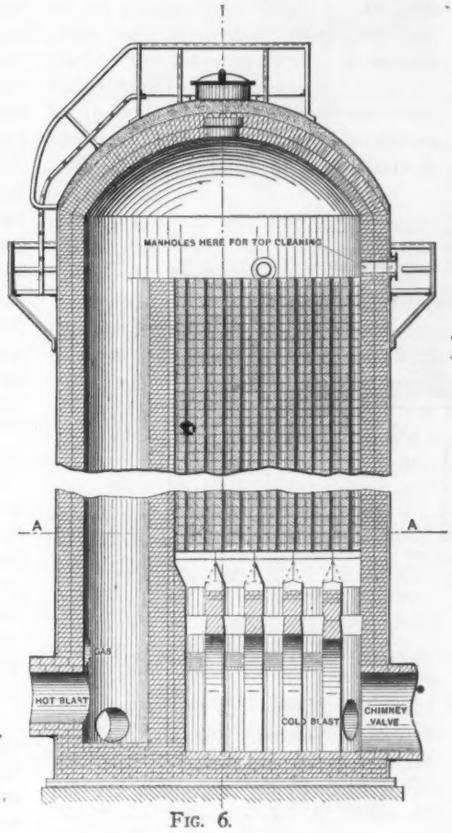

FIG. 6.

TYPES OF STOVES.

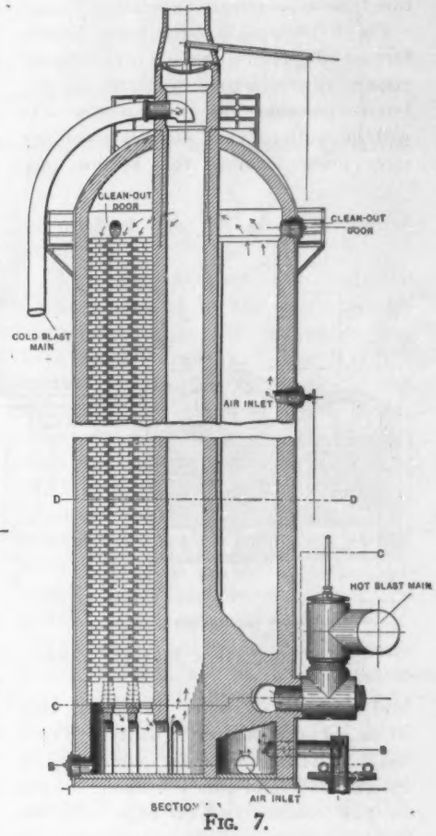

FIG. 7.

fusible and naturally attacks the brickwork and the less refractory the brick are the more thay are attacked. Another important quality demanded is that the brick should not scale off in service.

The space which it is necessary to leave between the shell and the brick work need not exceed 2½ inches as the temperatures in the stoves are less than those of the furnace. High authorities in construction advise that beneath the lower courses of the brick in the hearth of the stove there should be at least one inch of cement, and that the space between the shell and the jacket for six feet from the ground be grouted with cement. The lower portion of the shell of the that the manufacture of stove brick is a matter demanding the possession of high grade clays, full understanding of the conditions prevailing in stoves, and an organization and capacity to make brick in the manner in which they should be made. To meet this demand the most progressive manufacturers are using only selected hard and plastic clay and are using a greater portion of flint clay than was formerly employed in brick for stove linings.

A point that is sometimes lost sight of is the importance and advantage of having all the brick that go into a stove come from the same district and made from clays of a uniform and similar character. There is the brick around the hot blast valves, etc.

Open Hearth Furnaces.

The open hearth furnace is a regenerative gas furnace in which pig iron, wrought iron, steel, steel scrap, etc., are exposed to the direct action of the flame and converted into steel. Theoretically the regenerative principle is unlimited in its capacity for increasing temperatures. Practically it is limited by the refractoriness of the materials used in the construction of the furnaces, regenerators, etc.

The necessity, combined with the advantage, of running open hearth furnaces at the highest possible temperature render essential the use of the most refractory substance com-

mercially obtainable. The regenerative principle with its almost unlimited temperature possibilities demands the utmost care and intelligence on the part of those responsible for the operation of open-hearth furnaces.

From the point of view of the manufacturer of refractory materials, the basic open hearth furnace is of great interest. There are many more basic than acid open hearth furnaces, and the basic furnace is a consumer of practically all of the different refractory products that are manufactured on a commercial scale.

Fig. 8 showing a basic open hearth furnace illustrates the use of different classes of refractory material in different portions of the furnace. It will be noticed that directly over the steel plate forming the bottom, are

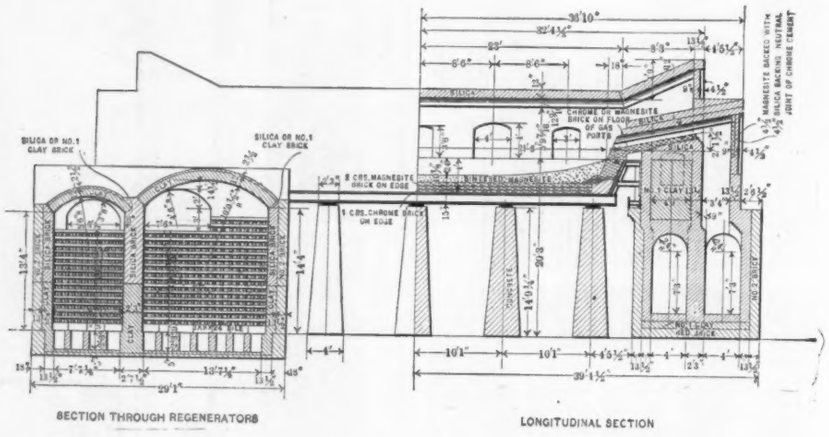
SILICA OR NO. 1 CLAY BRICK
SILICA OR NO. 1 CLAY BRICK
CHROME OR MAGNESITE BRICK ON FLOOR OF GAS PORTS
SILICA
MAGNESITE BACKED WITH SILICA BACKING NEUTRAL JOINT OF CHROME CEMENT
9 CRS. MAGNESITE BRICK ON EDGE
5 CRS. CHROME BRICK ON EDGE
CONCRETE
NO. 2 BRICK
SECTION THROUGH REGENERATORS
LONGITUDINAL SECTION

FIG. 8—BASIC OPEN HEARTH FURNACE, SHOWING BRICK FOR VARIOUS LOCATIONS.

laid courses of silica brick or clay brick of the highest quality. There may be three or four courses laid on the flats and joints broken, or one or two courses laid on edge with the joints broken. Over these courses come chrome brick, either on the flats or on the edge. Over the chrome brick are several courses of magnesia brick on edge, and then magnesia brick on their flats.

On this solid foundation of basic and neutral brick a magnesite bottom is sintered in at the rate of about 12 bags every four hours, averaging one-half inch at a time over the whole hearth. The rate at which the magnesite bottom is made depends of course on the heat in the furnace. The finished bottom averages from 15 to 24 inches thick with a probable average of about 18 inches. Basic slag is mixed with the magnesite in the proportion of from 10 to 20 per cent.

It is of course understood that in the basic as well as the acid process, the hearth is only a passive agent. It is simply the retort in which the metallurgical and chemical work is carried on. It is of interest to note that various substances other than magnesite have been used to make furnace bottoms, such as carbon, bauxite, chromite, lime and dolomite. Doubtless magnesite is the best material for the basic hearth. When properly put in the cutting by slag is very slight. Chromite, or oxide of chromium and iron, usually referred to as chrome ore, is one of the most infusible of substances and one of the best to resist both acid and basic substances. It is very difficult to fuse or sinter it into a solid impenetrable mass but it is within the bounds of possibility that chrome ore may find a useful field in making furnace bottoms, in addition to its present use in open hearth furnace practice. Heretofore its unsatisfactory mechanical structure has prevented its employment in this manner.

Practically every furnace bottom when broken up shows that melted metal has penetrated through the cracks and found its way to the enclosing shell containing the hearth. The vital necessity therefore of an ample foundation of basic brick, and of first class bricklaying with tight joints and joints properly broken, is apparent as a preventative of break outs. The bottom shell should be tightly riveted so that when the molten metal finds its way to the plate work, it cannot find an outlet but spreads over the bottom and finally chills. A loose rivet or improperly riveted joint invites trouble from break outs.

The roof and side walls should be built of the highest quality of silica brick. A good many large modern furnaces of fifty tons or over, have 12-inch brick in the walls and roof. A thick wall and roof prevent excessive radiation. Too great radiation means a long exposure of the charge to the gases, occasions increased loss by reason of greater oxidation and has other obvious disadvantages.

The kind and quality of brick which should be used in the uptakes, regenerator chambers and other portions of the furnace are well shown in Fig. 8. The portions of the open hearth furnace in which the heat regeneration is performed demand intelligence and judgment in the selection of the brick with which they are to be built. In some cases the importance of this matter is not given the attention necessary to insure the best and most economical results.

It is very essential that checker brick have the proper physical structure to absorb and give up heat readily. High grade refractory clay checker brick last two or three times as long as inferior or less refractory brick, and the percentage of high grade brick that can be used over again after cleaning checkers is much higher.

Producer gas is harder on brick than is natural gas. It is more variable in composition and carries a good deal of dust. This entails more frequent cleaning of checkers. Where the practice is severe and the heat in the checkers intense silica brick are sometimes used in the upper courses of the checkers. Magnesia brick have also been used with advantage in the upper courses of the checkers in some cases, where the dust, oxides, etc., carried over by the flame are especially destructive. The brick manufacturer who has gone into this subject thoroughly with a large proportion of the open hearth managers and superintendents whose practice and methods are recognized as being the best, alone realizes how important this matter is to the economical and successful operation of the furnace.

There is no furnace employed in metallurgy in which the economy of using only the very highest grade materials is so pronounced as in the basic open hearth furnace. Only brick of the very highest refractoriness are capable of withstanding the intense heats. The heat action is intensified by the scouring nature of the slag and also by the character of the deposit carried over by the gases into the chambers and flues. This deposit consists of sand, dirt, rust, scale, lime, ore, etc. Fine globules of metal are thrown up from the bath by the violence of the car-

bon reaction. These particles are immediately oxidized and the deposit therefore consists largely of finely divided iron oxide. This is exceedingly fusible and destructive of the brickwork.

It is absolutely essential that the design of the open hearth furnace be a correct one. No brick will stand for any length of time in a poorly designed furnace. An impinging flame rapidly destroys the most refractory brick, while the same brick will withstand an equal amount of radiated heat for a prolonged period. Any unusually rapid cutting out of a particular portion of a roof or wall may be set down to an impinging flame.

The necessity of heating up slowly all furnaces in which silica brick are used is occasionally lost sight of, especially in times of pressure for output. It has been proved beyond all question that the refractoriness of silica brick is reduced several hundred degrees by too rapid heating. Silica brick are very tender and susceptible to changes of temperature, and the utmost care should be used in heating them up slowly, evenly and continuously. The same care should be used in cooling down when the furnace is put out of commission. At least six to eight days should be taken and many furnaces take from ten days to two weeks, to bring them up to charging heat. It is undoubtedly true that the longer time is an advantage to the silica brick, whatever may be the objections from other points of view.

Silica brick should be laid dry. In the walls they should merely be trued up by dry ground silica. In the roof they should be grouted in with finely ground silica mixed with water to a thin soup and poured in between the joints.

Magnesite and Chrome.

The great importance of magnesia and chrome refractories to the iron and steel industry makes a chapter on them desirable. White magnesite is produced in small quantities in California and there is a large production in Greece. A small tonnage is shipped from India and South Africa. There are deposits in Swedish Lapland, Norway, Canada, Russia, New Caledonia and elsewhere.

White magnesite is not used in iron and steel furnaces to any extent and none of the magnesite found in these localities is of particular interest to the iron and steel trade which draws its supplies from the deposits in Austria-Hungary, and more particularly from those found about 250 miles north of the port of Trieste on the railway between Vienna and Trieste. Here the quarries of magnesite are developed in the most intelligent manner. The main body is about 6,000 feet long, and 600 feet deep and of varying width, depending upon the shape of the mountain. There are six benches running around the mountain from which the raw material is quarried. About 700 men are employed at the main quarry.

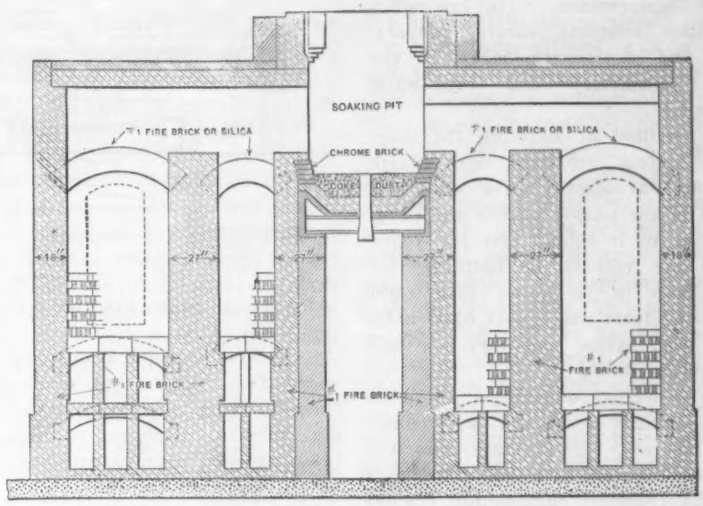

FIG. 9—SECTION OF SOAKING PIT, SHOWING LOCATION OF VARIOUS QUALITIES OF BRICK.

The quarried material must be very carefully selected as there are small veins of silica and dolomite slips running all through it and only an experienced eye can tell the difference. Nothing but lumps weighing from 5 to 30 pounds are sent to the kilns. There is a waste of 60 per cent of the material in quarrying, and everything is hand selected, no fine stuff being sent to the kilns. The quarried material loses about one-half its weight in calcining. About five tons of rock are quarried to produce one ton of dead burned magnesite.

There are between 500 and 600 hands employed in the calcining department. After the magnesite has been dead burned and has laid for several weeks it is crushed and dropped on to revolving sorting tables where it is again hand picked. The high price of coal, which ranges from $5.75 to $8.00 per ton at the kilns, is a serious item in the cost of preparation of dead burned magnesite for the market, as well as the cost of shipping to port, handling, sacking, ocean freight, insurance, etc.

The first Austrian or Styrian magnesite brought to the United States was a shipment of 800 tons bought in Europe in 1885 and the first basic steel in the United States was made in 1886. As practical experience was gained it was proved conclusively that the Austrian magnesite was the best for making basic bottoms. Its composition gives it the very valuable quality of fritting or setting at open

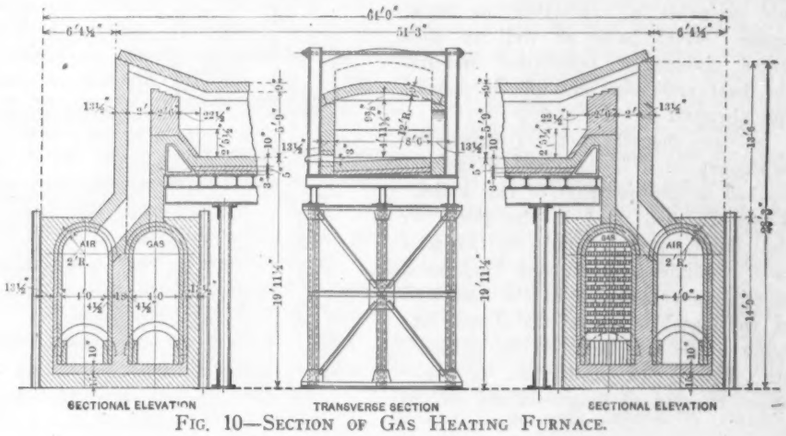

FIG. 10—SECTION OF GAS HEATING FURNACE.

hearth temperatures. Its low silica and lime contents, careful preparation, and uniformity make it the most satisfactory and economical magnesite.

The method of sintering the magnesite bottom into basic open hearth furnaces has already been described. When of the proper quality and properly put in it should last for years. There are records of bottoms that have been in for more than eight years and from which over 6,600 heats have been taken, and they are still in good condition.

The principal advantages of magnesite bottom compared with other materials are. 1. Its longer life and greater dependability. 2. The fact that its chemical composition enables it to resist better than any other material, the action of basic slag. 3. It is practically unaltered by exposure to the atmosphere unless this exposure be unduly prolonged. It may then absorb moisture and carbonic acid gas to a small extent. 4. It is not liable to rot and break up by absorption of metal and slag. 5. It can be used over and over again. 6. Many more heats of basic steel can be made on magnesite bottom than on any other bottom before renewal is necessary. 7. Repairs are relatively small and unimportant and can be quickly performed. 8. It agglomerates well and patches do not come up to the surface. Patches of the basic bottom on the surface of the bath would retard the operation. 9. Magnesite can come in direct contact with silica brick without danger of fusion.

Several patents have been taken out for making the furnace block of magnesite and considerable success is claimed for one or two methods of using magnesite in this portion of the furnace. Dolomite is used to a considerable extent in making furnace repairs but it is not nearly as efficient and valuable a refractory as magnesite. With basic as well as with other classes of refractory material the best and most durable is usually the cheapest in the end.

In open hearth furnaces magnesite brick are used in the bottom as described in another part of this article. They are also used in the ports, in the jambs and around the tapping hole. Magnesia brick have been used in the upper portion in the backwall of the uptakes where the flame carrying over the dust, oxide of iron, etc., strikes the wall. Six or eight upper courses of magnesia are put in

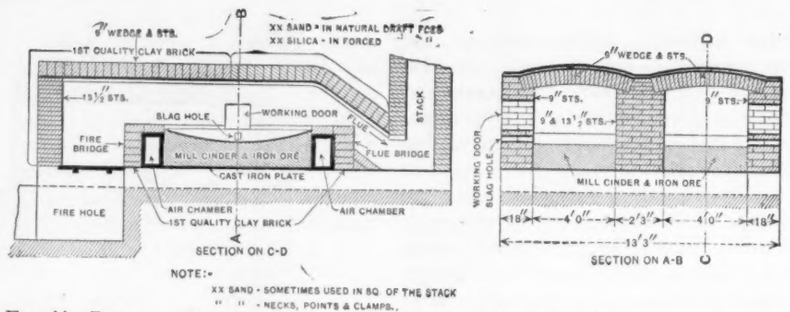

FIG. 11—PUDDLING FURNACE, SHOWING LOCATION OF VARIOUS QUALITIES OF BRICK.

the checkers at some plants and it is stated that repairs and renewals to checker work are cut down. As the valuable qualities of magnesia brick become better understood, their use is bound to increase.

In the furnaces used in the manufacture and treatment of iron and steel they are used in the six or eight courses of soaking pits; in the bottom and bridge walls of continuous gas billet heating furnaces; in the bottoms and around the tap holes of coal fired heating furnaces; in puddling furnaces over the chill; in the bottom and sidewalls to the slag line of mechanical puddling furnaces; on the metal slag line of metal mixers; on the bottom of small riveting and heating furnaces; in dolomite calcining kilns, etc., etc.

It is of interest to note that magnesia brick are much better in quality than they were a few years ago. The greater experience of the manufacturers and better knowledge of the conditions under which they are used has gradually brought this about.

Chrome Ore and Chrome Brick.

The best chrome ore for use as a refractory is found in Greece. Deposits of chrome ore are also being worked in California, Turkey, New Caledonia, Canada and elsewhere. The manufacture of chrome brick requires a great deal of care and attention.

Chromite was first tried in its natural state as a refractory in 1879 at the Petersburg Alexandrofsky Steel Works in St. Petersburg, Russia. It is exceedingly refractory and neutral in character; being neither acid, basic, reducing or oxidizing. Heated in lumps it does not crumble or decrepitate, however high the temperature. In the open hearth furnace, chrome ore is used as a neutral to separate the silica brick from the magnesite, and also in paving floors of ports and as a protection to the walls of the gas ports. Other places for it are as a protection to the bulkheads and especially on the bank of the furnace under the back wall. At some plants it is mixed with magnesite in making the stopper for the tapping hole. A well known open hearth superintendent uses it as a wash for the checker brick. At plants having tilting furnaces it is used on the skewback line of the furnace. It has also been employed to patch up jambs where the charging machine cuts out silica and magnesia brick.

Chrome brick are used in the bot-

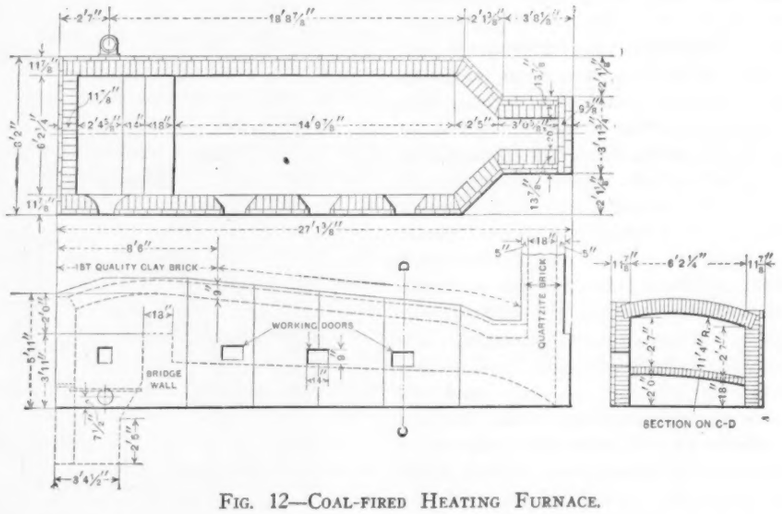

FIG. 12—COAL-FIRED HEATING FURNACE.

tom of the open hearth furnace as previously described. They have proved economical in the six or eight bottom courses of soaking pits, and are also used in the same wall as magnesia brick in some heating, puddling, scrap and other furnaces and also in metal mixers, calcining kilns, etc.

It may be put down as a general rule that magnesia or chrome brick will prove economical in any place in any kind of iron and steel furnace where basic or scouring slags cut out fire clay or silica brick rapidly.

Soaking Pits.

The intense heat in the pits and the fact that there is very little radiation demand the use of very high grade refractories. The use of fire clay wedge brick, 13½ to 18 inches long, in forming the arch is preferable to building them of the regular 9-inch shapes, as the large brick have been built of quartzite brick and they are giving excellent service.

Bessemer and Tropenas Converters.

Compared with the open-hearth furnace the Bessemer converter is a very small consumer of refractories per ton of output. The question of getting good tuyeres is frequently a serious one, and not every manufacturer can turn out well fitting blocks for the bottom. Silica brick make the best lining for Tropenas converters and the proper grind and burn of the brick are important in securing the best results.

Malleable Furnaces.

In no other type of furnace is the cost of refractories per ton of output greater than in malleable furnaces. The service is exceedingly severe, and in the bungs especially only the very highest grades of fire clay brick of uniform quality will meet the conditions.

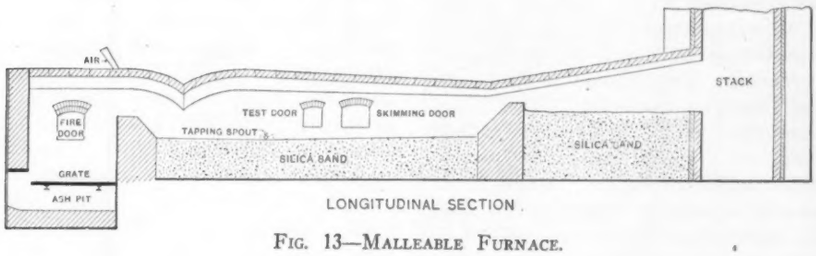

FIG. 13—MALLEABLE FURNACE.

a better bearing and diminish the possibility of distortion and falling in of the arch. Some furnace superintendents are using silica brick in the arches over the ports, laying three 4½-inch courses. Very satisfactory results have been obtained, as the silica arches hold their shape in an excellent manner. The clay brick piers are built after the arches are laid and the arch does not bear on the piers. It takes from 30,000 to 40,000 brick to build a soaking pit, including the checkers.

The use of magnesia or chrome brick in the six or eight lower courses of soaking pits has proved a decided economy. The slag which collects in the bottom of the pit cuts out clay brick rapidly, allowing the walls to fall in. Magnesia or chrome brick obviate this trouble.

Continuous Gas Heating Furnaces.

Fig. 10, showing a gas heating furnace, illustrates the various uses of refractories in furnaces of this type. Conditions are very severe, very high heats being reached. Some large plate mill heating furnaces are built of silica brick and very satisfactory results are claimed. Many furnaces have

The reasons for the very rapid destruction of brick may be summarized as follows: Intense heat is attained by the use of good flaming non-coking coal burned under draft or blast pressure. There is an excess of heat in the furnace over that required to melt the charge, and an excess of fuel over that employed in other types of melting furnaces, partly because of certain advantages to the malleable iron manufacturer, and partly by reason of the class of material charged. Another reason is the fact that furnaces are charged full or almost full up to the roof. This has the effect of throwing the flames and heat directly against the brick in the bungs and elsewhere. It is a well known fact that an impinging flame burns out brick work much more readily than does radiated heat. The removal of the roof (bungs) in order to charge, while the brick are almost at the working heat of the furnace, is also damaging to the brick. Practically no brick known will stand this without more or less spalling. Bringing up heats quickly is also exceedingly hard on all classes of brick work.

In order to obtain the best results the brick in the bungs should be laid dry, and then grouted with a very thin fire clay cement, rubbing and fitting to insure a brick-to-brick joint. They should be laid evenly without any one brick projecting beyond its fellows.

It is impossible to emphasize too strongly the value of first class bricklaying. If one brick projects downwards from a roof lower than its fellows, it catches the heat and burns or spalls off. If, in breaking off, it breaks above the level of the brick laid next to it, the hole causes a swirling flame which soon burns off the brick surrounding the hole and the destruction of the roof proceeds rapidly.

The same clay as that of which the brick are made should always be used in laying them, and not more than 300 to 350 pounds of clay to 1,000 9-inch brick. The brick should be kept dry both in the sheds and in the foundry. Bungs should not be put on wet floors when the brick are red hot. Brick that are used as soon as possible after taking from the kilns give somewhat longer service than if they have been stocked for some time, as all brick suitable for use in bungs are more or less porous and absorb moisture. When this moisture is driven out by the rapid heating up in the furnace it has an injurious action on the bond of the brick, and makes them less tough and less able to stand the strain of rapid heating up and cooling down.

It is important to remember that brick of hard burn and fine grind should be used for the fire box walls and sides of the furnace as they will stand the wear in the fire boxes and the flow of metal and slag better than the lighter burned brick used in the bungs.

Some manufacturers have trouble because of their stack chambers burning out, especially where the stack is quite near the furnace, and where the flame, as it leaves the furnace, strikes the back wall of the stack. The use of a deflecting wall or any device which will give a rotary movement to the flames as they leave the furnace and enter the stack helps to save the back wall. An impinging flame is always very destructive of brick work and any plan that prevents it lengthens the life of the fire brick.

Some manufacturers have devoted considerable thought and care to making special blocks for use in the annealing furnaces. The heat in the flues and the wear caused by wheel-

ing the annealing boxes in and out makes it economy to use specially made blocks of special size, mix and burn.

Puddling Furnaces and Coal Fired Heating, Scrapping and Bushveling Furnaces.

Some of the illustrations show the approved construction and use of refractories in furnaces used in the refining and treatment of wrought iron. The roof over the fire box and the

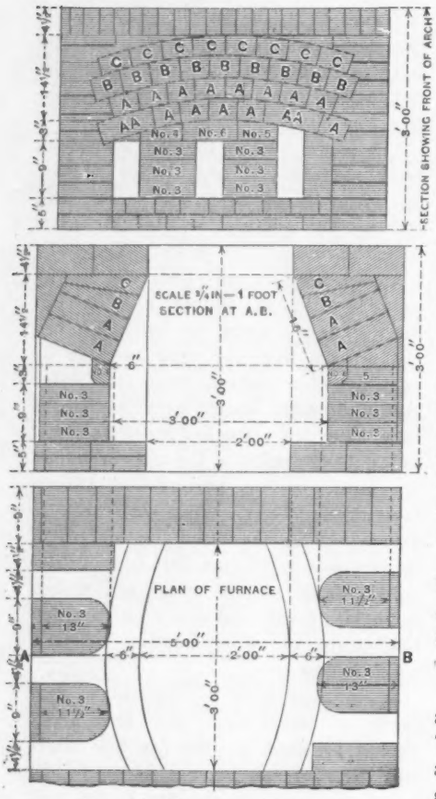

FIG. 14—CRUCIBLE FURNACE.

necks and squares and around the tapping hole require frequent renewals and repairs, and here the economy of using only the highest grade and most suitable brick is most evident.

The use of draft or blast or of steam increases the severity of the working conditions and makes the use of the highest grade brick imperative, if true economy in the use of refractories is to be reached.

Electrical Furnaces.

The rapid increase in and successful operation of electrical furnaces during the past few years makes an article on refractories incomplete without at least some brief mention of them.

Magnesia brick or chrome brick are practically indispensable in lining these furnaces, and it is very interesting to note the continually widening use of basic refractories in the various types of electrical furnaces devoted to the production of ferro-alloys and the finer grades of steel. Where dead burned magnesite is used in lining electrical furnaces it is mixed with 12 per cent of tar. About three tons of magnesite are required to line the usual type of electrical furnace now in operation.

Some Practical Hints.

The building of different parts of furnaces has an important bearing on the life. Suitable shapes of brick which are in practical use in building and repairing walls, ports, arches, etc., in the least time and with the smallest amount of cutting should be used. Complicated or difficult shapes should be avoided as much as possible. These cannot be re-pressed, are more liable to irregularity and cracks and are not as strong as regular standard shapes.

All brick should be kept dry and handled carefully to avoid scuffing and cornering. They should be laid with the smallest possible joints. Not more than 300 to 350 pounds of ground clay, etc., should be used to lay 1,000 9-inch equivalent. Brick joints should be properly broken. The more symmetrical an arch the stronger it is.

The brick of greater taper should be placed towards the center of the arch. Straights and taper brick should interchange as much as possible, and two straights should be avoided.

All brick work should be heated up and cooled down slowly and evenly. The use of high grade refractories and an observance of the instructions given above will banish or diminish many of the troubles inherent in the operation of furnaces at the intense heats demanded in the manufacture and treatment of iron and steel under modern conditions.

The Interstate Brick Co., Lowellville, O., with $100,000 capital stock, has been incorporated by Robert Bentley, Walter L. Kauffmann, M. S. Logan, H. T. McCartney and Frank D. Zug. The company will manufacture brick and paving block at Hillsville, Pa.

With the expiration Dec. 31 of the 60 days notice posted at the Bessemer plant of the Republic Iron & Steel Co., at Youngstown, O., no wage change of employes will result since no adjustment was asked by either employers or employes.

DEVELOPMENT OF CUBAN ORE PROPERTIES.

President E. C. Felton, of the Pennsylvania Steel Co., who has returned from an inspection of the Spanish-American Iron Co.'s ore properties in Cuba, is quoted in reference to the old workings near Santiago on the south coast of the island as follows:

"These mines show no falling off in the possible amount of ore, and while they have probably reached their maximum of output, a large tonnage may be expected from them for many years to come. The small de-

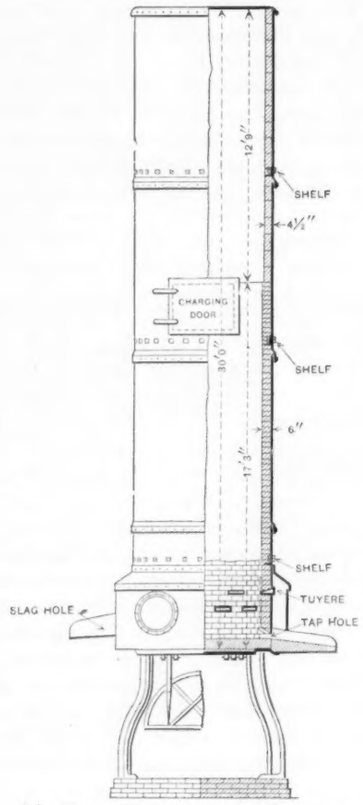

FIG. 15—HALF SECTION AND ELEVATION OF CUPOLA.

mand for steel products in 1908 did not allow of the consumption of the entire product of these mines by the Pennsylvania Steel Co., and the Maryland Steel Co., yet the mines have nevertheless been operated during the year to their full capacity, and the surplus ore stock mined, in excess of 200,000 tons, has been piled near the mines, where it is available when needed by the two steel companies."

He found the work on the new property near Mayari, on the north coast, well advanced, and the construction of railroads and terminals nearly completed. It is expected that shipments of ore from this property will begin about the middle of 1909.

The Business Recovery in 1908

The most striking feature of the financial year 1908 was the early appearance of forces which made for repair and recuperation following the collapse of the previous autumn. It opened with the usual weakness and uncertainty incident to an after-panic year. But steadily these distinctive features have given way to hopefulness as evidenced by the steady rise in the prices of shares and the ready absorption of bond issues.

The year opened with call money bringing 20 per cent, but six days later it had declined to 2 per cent. The Bank of England on Jan. 2 lowered its discount rate from 7 per cent, which it had maintained for six weeks, to 6 per cent. In all seven national financial institutions reduced their rates that month. Banks began returning to a cash basis, clearing house certificates being retired. New York clearing house banks opened the month with a deficit in reserve requirements of $16,500,000 but they closed January with $37,000,000 in excess of reserve requirements. By June the surplus reserve had increased to $70,000,000, the largest since 1894. Call money ran along for weeks uninterruptedly at 1½ per cent. Little effect was produced by the return in February to Europe of $50,000,000 in gold obtained during the money stress of the previous autumn. The success of new bond issues like the New York city loan of $50,000,000 or the $40,000,000 Pennsylvania railroad 4s proved elements of financial strength. In fact the success of bond issues throughout the year was regularly remarked upon. Quiet reigned in July but afterward the gain was steady until in November bank clearings were the largest for the year. The surplus reserve dropped in December to $16,900,000 without causing uneasiness even when accompanied by gold exports to Europe. After February the movement of currency from the interior banks to New York was of such steadiness and volume that rates were kept down. Even crop financing was done principally by western banks.

The stock market advance began immediately after the opening of the new year but a sharp reaction in February sent prices downward, some to even lower figures than in October previous. Various things combined in the early spring to lift prices and after the mid-summer lethargy had worn off further advances were scored steadily to the close of the year.

The number of business house failures for the first quarter was 59 per cent over that of the same period in 1907; in the second quarter, 56 per cent; and the third quarter, 49 per cent, the average increase for the year being but 37 per cent, but the liabilities shrank 21 per cent from those of the preceding year. Building activity resulted in the decrease in expenditures being but 10 per cent in comparison with 1907. The commodity price movement to the low point, June 1, showed a fall of 15 per cent, of which loss 7 per cent has since been regained. Immigration fell off 67.2 per cent and labor strikes increased 31 per cent, one coal dispute in the spring furnishing the larger part of the percentage of increase. Railroad building showed a decrease of 37 per cent. The aggregate capitalization in five leading states was the lowest since the formation of large corporations began, being $1,164,553,250, compared with $1,305,005,000 in 1907. Aggregate dividend and interest disbursements for the year were $1,245,848,788, compared with $1,325,618,784 in 1907.

The total transactions in railroad and state bonds during the year amounted to $965,153,400, compared with $509,898,142 the previous year. Total sales of listed shares reached 163,603,602, compared with 157,350,838 in 1907.

THE LEADING INDUSTRIAL SECURITIES.

	Closing Quo. Dec. 31, 1908	Closing Quo. Dec. 28, 1907	Changes in Year 1908	Return on Investment Per Cent	Dividend Basis	Dividend Last Declared	Dividend Date Last Div. Pay.
Allis-Chalmers	15¾	5⅝	+10¼	.....			
Allis-Chalmers pr	49½	17	+32½	.....	7 cum	1¾ Q.	Feb., 1904
American Can	9	4	+5	.....			
Am. Can pr	73⅜	41½	+31⅞	9.65	7 cum	1¾ Q.	Jan., 1909
Am. Car & Foundry	50⅜	31	+19⅜	4.00		¾ Q.	Jan., 1909
Am. Car & Fdy. pr	109	83¼	+25¾	6.36	7 n. c.	1¾ Q.	Jan., 1909
American Loc	57¾	34⅜	+23¼	8.70	5	1¼ Q.	Aug., 1908
American Loc. pr	113	86⅝	+26⅜	6.21	7 cum	1¾ Q.	Jan., 1909
American Ship	57	44⅝	+12⅜	6.96	4	1 Q.	June, 1908
American Ship pr	105½	85	+20½	6.67	7 n. c.	1¾ Q.	Oct., 1908
Am. Steel Foundries(new	39⅜	....	.....	.....			
Am. Steel Foundries. pr.	47½	28½	+19	.... ..	6 cum	2½	Aug., 1904
Barney & Smith	40	65	−25	.....	4	1 Q.	Sept., 1907
Barney & Smith pr	110	128½	−18½	7.27	8 cum	2 Q.	June, 1908
Bethlehem Steel	24½	8½	+16	.....			
Bethlehem Steel pr	54⅞	23	+31⅞	.....	7 n. c.	¾ Q.	Feb., 1907
Cambria Steel	39½	27	+12½	15.50	6	1½ S. A.	Aug., 1908
Cambria Iron	46½	43	+ 3½	8.60	4	2 S. A.	Sept., 1908
Chicago Pneumatic Tool	27½	22	+ 5½	.....	4	1 Q.	Oct., 1907
Colorado Fuel	40	19	+21	.....		3¼	April, 1902
Crucible Steel	8	6	+ 2	.....			
Crucible Steel pr	57½	55⅝	+ 2¼	.....	7 cum	1 Q.	Dec., 1907
Empire Steel	6	5	+ 1	.....			
Empire Steel pr	47	52	− 5	12 63	6 cum	3 S. A.	July, 1908
Fay & Egan	90	100	−10	6.67	6	1½ Q.	Nov., 1908
Fay & Egan pr	100	128½	−28½	7.00	7 cum	1¾ Q.	Nov., 1908
General Electric	158	112	+46	5.08	8	2 Q.	Oct., 1908
Harbison-Walker	17⅛	14½	+ 2⅝	.....		½	Oct., 1907
Harbison-Walker pr	80	69½	+10½	7.50	6 cum	1½ Q.	Oct., 1908
International Pump	39¼	13½	+26	.....		1	April, 1905
International Pump pr	84	65¼	+18¾	7.32	6 cum	1½ Q.	Nov., 1908
Lackawanna Steel	47	24	+23	.....			
Lake Sup. Corp	16	3¾	+12¼	.....			
New York Air Brake	93	51½	+41½	.....	8	2 Q.	Oct., 1907
Niles-Bement-Pond	97	130	−33	6.15	6	1½ Q.	Dec., 1908
Niles-Bement-Pond pr	100	105	− 5	6.00	6 cum	1½ Q.	Nov., 1908
Otis Elevator Co	42	20	+22	7.08		1¼ S. A.	April, 1908
Otis Elevator Co. pr	97	68	+29	6.15	6 n. c.	1½ Q.	Jan., 1909
Penn. Steel	50	57	− 7	.....			
Penn. Steel pr	103¾	82	+21½	6.75	7 n. c.	3½ S. A.	Nov., 1908
Pittsburg Coal Co	14	8	+ 6	.....			Nov., 1906
Pittsburg Coal Co. pr	49	42¾	+ 6¼	....	7 c.	1¾	April, 1905
Pressed Steel Car	43⅝	18⅜	+25⅜	.....		3	Aug., 1904
Pressed Steel Car pr	102	67	+35	6.78	7 n. c.	1¾ Q.	Nov., 1908
Pullman	171	146	+25	4.69	8	2 Q.	Nov., 1908
Railway Stl. Spring	48	26	+22	8.40	4	2 S. A.	Oct., 1908
Railway Stl. Spring pr	102½	77	+25½	6.77	7 cum	1¾ Q.	Sept., 1908
Rep. Iron & Steel	25¾	16¼	+ 9½	.....			
Rep. Iron & Steel pr	86	66	+20	8.19	7 cum	1¾ Q.	April, 1908
Sloss-Sheffield	77⅜	35	+42½	6.45	5	1 Q.	Dec., 1908
Sloss-Sheffield pr	110	80	+30	6.36	7 n. c.	1¾ Q.	Jan., 1909
U. S. Pip & Fdy	29¾	20⅛	+ 8¾	.....	4	1 Q.	Dec., 1907
U. S. Pipe & Fdy pr	75¾	56	+19¾	9.31	7 n. c.	1¾ Q.	Sept., 1908
U. S. Steel	53⅞	26⅝	+27¼	3.71	2 n. c.	½ Q.	Dec., 1908
U. S. Steel pr	118¾	87½	+25½	6.20	7 cum	1¾ Q.	Nov., 1908
U S. Steel 5;	103	84⅞	+18⅛	4.81	5	5 A.	.....
Va. Iron, Coal& Cke	62¼	38	+24¼	.....			
Westinghouse Elec	84¾	42	+42¾	.....	10	2½ Q.	Oct., 1907
Westighouse Air Brake	110¾	133	−22¼	9.09		2½ Q.	Jan., 1909

Par value of shares, $100, except those starred (*), $50

IRON AND STEEL CHRONOLOGY FOR 1908

January.

1—H. C. Frick Coke Co. reduces wages of operatives in Connellsville regions 9 per cent.

2—Total iron ore receipts at Lake Erie ports during 1907 anounced as 35,195,758 tons. Ore on dock Dec. 1, 1907, 7,385,728 tons.

4—Valley furnace interests attempt to establish $17 furnace price on No. 2 foundry for first half. Two furnaces decline to cooperate.

6—Tin plate prices reduced 20c to $3.70 per base box. Sheet reductions made amounting to $2 on black sheets, $4 on galvanized, $1 on blue annealed and $2 on painted and galvanized roofing. Gages 29 and 30 black and galvanized sheets reduced $4 and $6, respectively.

7—Western Bar Iron Association reduces prices $4 per ton to 1.40c base Pittsburg for western shipment, and $2 per ton to 1.50c base for Pittsburg district distribution.

8—United States Steel Corporation fixes price of preferred stock to employes in profit-sharing plan at $87.50.

10—American Society for Testing Materials adopts steel rail specifications.

11—Manufacturers of wire products reaffirm prices.

13—Bi-monthly bar iron scale settlement shows November-December shipments average between 1.55c and 1.60c, calling for a $6.37½ puddling rate for January and February as against 1.60c and $6.50 puddling rate in November and December.

14—Bi-monthly sheet and tin plate wage settlement shows no change in schedule for January and February, sheets remaining 2 per cent and tin plate 6 per cent above base.

15—Eastern makers meet the cut of western mills in bar iron prices.

17—Ohio works of Carnegie Steel Co. resume operations.

23—Carnegie Steel Co. reduces light rails $2 per ton, making official price $28 on sections 25 to 45 pounds.

28—United States Steel Corporation announces earnings of $25,876,197 for last quarter, and 4,634,553 unfilled tonnage.

30—Steel makers hold second meeting in New York and reaffirm prices on finished material.

February.

3—Brier Hill Iron & Coal Co. awards contract for rebuilding its Grace furnace.

4—Total shipments of iron ore in 1907 from Lake Superior regions announced as 42,245,070 tons, of which 4,288,755 tons were by water and 956,315 tons by rail.

5—Western bar iron makers advance prices $2 a ton to 1.50c Pittsburg base.

6—January pig iron production announced as 1,081,813 gross tons.

7—Ore prices of 1907 reaffirmed at meeting of selling interests in Cleveland.

8—Makers of foundry iron meet in Cleveland and endeavor to fix $17 valley as general price on No. 3.

10—Announcement made that the Pennsylvania railroad has placed first large rail order of the year amounting to 55,000 tons.

13—Independent sheet makers reaffirm prices.

17—New foundry pig iron schedule adopted by makers of central west, fixing $17 base for No. 2 at principal consumptive points plus switching charges.

20—Railroads order 60,000 tons of rails, of which 45,000 are taken by the Great Northern railroad.

21—Sheet and tin bar prices readjusted to a basis of $29.50 delivered in Pittsburg, valley and Wheeling territory and $29 Pittsburg for delivery to other points, effective March 1.

March.

5—February pig iron production shown to be 1,233,074 gross tons.

6—Youngstown Sheet & Tube Co. purchases plant of Morgan Spring Co. at Struthers, O.

9—Announcement made that Republic Iron & Steel Co. has given notice of intention to withdraw from continuous working agreement with the Amalgamated Association of Iron, Steel and Tin Workers.

11—Bi-monthly settlement of bar iron schedule shows puddling rate of $6.12½ for March and April based upon 1.45c bar iron card.

12—Sheet and tin bar wage settlements for March and April made at base on sheets and 2 per cent above base on tin plate.

14—New continuous working agreement entered into between Western Bar Iron Association and Amalgamated Association of Iron, Steel and Tin Workers.

19—Iron and steel manufacturers meet in New York and reaffirm prices on finished material.

20—Eastern Pig Iron Association and eastern bar iron makers reaffirm prices.

21—Nut and bolt makers reaffirm prices.

23—Annual report of United States Steel Corporation shows total yearly net earnings of $160,964,673.

24—New York Central railroad orders 24,000 tons of rails from the Lackawanna Steel Co.

25—Western bar iron makers reaffirm prices.

26—New arrangement on billet prices effective, whereby mills absorb one-half of freight when more than $1 and not exceeding $3 a ton over $28 Pittsburg base.

27—American Sheet & Tin Plate Co. operating 76 per cent of capacity, 5 per cent less than corresponding date in 1907.

30—Foundry pig iron price arrangement of $17 delivered for No. 2 in middle west becomes inoperative through certain interests acting independently.

31—Receivership of Westinghouse Machine Co. is lifted.

April.

1—American Iron and Steel Institute is organized to promote the best interests of the iron and steel industry of the country.

2—Iron and steel manufacturers discuss conditions at New York and reaffirm prices.

3—Cotton tie market of the year opens at 85c for 3,000 bundle lots and 88c on less amounts.

6—March pig iron production shown to be 1,229,856 gross tons.

8—Southern pig iron makers discuss conditions, but reach no agreement.

10—Lake Carriers' Association declares for the open shop and reaffirms wages of the past year.

15—Independent sheet and tin plate makers reaffirm prices.

16—Pennsylvania railroad makes public its rail specifications.

17—Pig iron producers meet in various sections and express themselves in favor of holding prices firm.

20—Stockholders of the United States Steel Corporation have annual meeting and re-elect directors.

21—American Railway Association adopts specifications for Bessemer and open-hearth rails.

22—Pennsylvania railroad's $40,000,000 bond issue is over-subscribed, indicating improved financial conditions.

23—First iron ore sale of magnitude of the season made at full price.

24—Rumors of new $10 Birmingham basing rate for No. 2 southern iron excites pig iron market.

27—Western Bar Iron Association reaffirms prices.

28—Directors of United States Steel Corporation meet and re-elect officers.

May.

1—Wage committee of the Amalgamated Association of Iron, Steel and Tin Workers meets in annual session at Youngstown. Canadian "anti-dumping" clause on tin plate in effect.

4—First ore shipment of the season leaves the head of the lakes.

5—Annual convention of the Amalgamated Association of Iron, Steel and Tin Workers opens at Youngstown.

7—General meeting of pig iron makers and ore sellers held at New York and conditions are discussed.

8—April pig iron production shown to be 1,155,122 gross tons.

May-June bar iron settlement fixes boiling rate at $6.12½ based on a 1.45c selling card. Sheet and tin plate settlement made at base rates.

12—Amalgamated Association of Iron, Steel and Tin Workers adopts 1907-08 scale as its convention scale.

14—Ore shipments from lower lake ports to furnaces up to May 1 announced as 31,692,446 tons, the heaviest on record.

21—Iron and steel makers again meet in New York and reaffirm prices.

25—Heavy buying of pig iron noted in all markets.

26—Lackawanna Steel Co. takes contract for 7,000 tons of steel sheet piling for Buffalo harbor improvement.

June.

1—Western Bar Iron Association and Amalgamated Association of Iron, Steel and Tin Workers meet at Cambridge Springs, Pa., to confer on annual wage scale.

2—Reductions of $4 a ton in steel bars to 1.40c Pittsburg, of $4 a ton in small shapes to 1.50c Pittsburg, of $4 in hoops to 1.80c Pittsburg, of $4 in bands to 1.40c Pittsburg and of $2 a ton in bar iron to 1.40c Pittsburg with 1.32c for western shipment, are announced.

4—Western Bar Iron Association and Amalgamated Association of Iron, Steel and Tin Workers adjourn conference without reaching wage agreement.

6—May pig iron production shown to be 1,068,002 gross tons.

8—Page Woven Wire Fence Co. closes contract with W. P. Snyder & Co. for 2,500 tons of basic monthly over three years, starting July 1, price being fixed by sliding scale.

9—General reduction in finished steel prices made. Billets lowered from $28 to $25 Pittsburg, sheet bars from $29 to $27 Pittsburg, plates from 1.70c to 1.60c Pittsburg, large shapes from 1.70c to 1.60c Pittsburg, wire products from $2.05 to $1.95 Pittsburg and merchant pipe $4 a ton.

11—Ore prices are reduced 50 cents a ton.

12—Sheet and tin plate makers decide to make no change in prices.

13—Iron pipe makers meet the $4 cut in steel pipe prices.

22—Republic Iron & Steel Co. and Amalgamated Association of Iron, Steel and Tin Workers meet to discuss wage scale.

23—Republic Iron & Steel Co. and Amalgamated Association of Iron, Steel and Tin Workers fail to reach wage agreement and adjourn conference.

24—Western Bar Iron Association and Amalgamated Association of Iron, Steel and Tin Workers arrange second wage conference at Detroit July 7.

25—American Sheet & Tin Plate Co. and Amalgamated Association of Iron, Steel and Tin Workers meet to settle annual wage scale.

29—American Sheet & Tin Plate Co. arranges and signs annual wage scale with Amalgamated Association of Iron, Steel and Tin Workers, providing 2 per cent reduction to sheet workers and 6 per cent reduction to tin plate workers.

30—Annual wage scale between Republic Iron & Steel Co. and Amalgamated Association of Iron, Steel and Tin Workers expires. Republic mills closed for inventories.

July.

1—Reports that steel bars had weakened to 1.20c base in Chicago territory officially denied.

2—American Sheet & Tin Plate Co. signs annual wage scale with International Tin Plate Workers' Protective Association.

3—Water freight rate on iron ore from Lake Superior ports reduced 10 cents to 65 cents a ton.

4—Announcement of successful application of the Gayley dry blast process in the steel works operations of the Illinois Steel Co. at Chicago.

6—New No. 1 stack of the Shenango Furnace Co. at Sharpsville, Pa., is blown in.

7—Second conference between the Western Bar Iron Association and the Amalgamated Association of Iron, Steel and Tin Workers opens at Detroit.

8—Carnegie Steel Co. acquires the plant of the Schoen Steel Wheel Co. at McKees Rocks, Pa.

9—June pig iron production shown to be 1,106,300 gross tons.

10—Western bar iron makers reaffirm prices on the basis of 1.40c Pittsburg.

11—Wage agreement reached between Western Bar Iron Association and Amalgamated Association of Iron Steel and Tin Workers providing average reduction of from 7 to 8 per cent.

16—Penalty clause for season's ore contracts adopted, providing larger rebates to furnaces where analyses fall below guarantee.

17—Republic Iron & Steel Co. signs annual wage scale with Amalgamated Association of Iron, Steel and Tin Workers on same basis as Western Bar Iron Association agreement.

18—July-August bar iron settlement fixes boiling rate at $5.37½ per ton based on a 1.35c selling card by the new scale. Sheet and tin plate settlement fixed at base rates by the new scale.

24—Chesapeake & Ohio railroad orders 10,000 tons of rails.

August.

3—Otis Steel Co., Cleveland, announces plans for new plate mill.

4—Pittsburg Steel Co. starts operations in new steel works and finishing mills at Monessen, Pa.

5—Corrigan, McKinney & Co. buy site at Cleveland and announce plans for the erection of two blast furnaces.

6—July pig iron production shown to be 1,228,604 gross tons.

7—Harriman steam lines enter the market for 7,000 freight cars.

20—Pittsburg Steamship Co. places orders for two steel ore vessels.

24—New Miami furnace of Hamilton Iron & Steel Co. near Hamilton, O., goes into blast.

24—Chicago & Alton railroad places contract for 1,000 steel cars with the Standard Steel Car Co., first large order of the year given.

26—Rebuilt Eliza No. 4 stack of Jones & Laughlin Steel Co. goes into blast.

27—Nut and bolt makers meet in New York and discuss plans for avoiding ruinous competition.

September.

3—Harriman lines place orders for 5,130 freight cars.

4—Nut and bolt makers revise price schedules.

8—Coal miners' strike in the south is settled. A. M. Byers & Co. break ground for new puddle and skelp mills at Girard, O.

9—September-October bar iron settlement made at a $5.25 boiling rate based upon a 1.30c selling card. Sheet and tin plate settlements continued at base rates.

10—August pig iron production shown to be 1,366,019 tons.

11—Pittsburg Steamship Co. announces it will grant usual wage increase Oct. 1.

16—Announcement made of $2,000,000 contemplated improvements for the plant of the Tennessee Coal, Iron & Railway Co. at Ensley, Ala.

23—Rebuilt Grace stack of the Brier Hill Coal & Iron Co. at Youngstown blown in on Bessemer.

25—Drouth in the western Pennsylvania coke regions curtails operations.

26—Oliver Iron Mining Co. announces plans for the building of large concentrating plant on the Mesabi range.

October.

1—Railway spring interest places order for 25,000 tons of steel with the Inland Steel Co.

5—Chicago & Alton railroad orders second lot of 1,000 steel freight cars from the Standard Steel Car Co.

8—September pig iron production shown to be 1,416,252 gross tons.

9—Algoma Steel Co. places contracts for about 200,000 tons of Pocahontas coke.

10—M. A. Hanna & Co. take option upon river site at Buffalo and announce plans for the building of two additional blast furnaces.

16—Pittsburg Steel Co. closes five-year contract for basic pig iron, 6,000 tons monthly, beginning Jan. 1, 1908, with the Penn Coal & Iron Co., the price being fixed by a sliding scale based upon production costs.

17—New furnace of Wickwire Steel Co., Buffalo, blown in.

23—Chicago & Northwestern railroad awards 24,000 tons of fabricated steel to the American Bridge Co. for terminal improvements in Chicago.

26—President Hoadley, of the Alabama Consolidated Coal & Iron Co. announces plans to eventually build steel works at Gadsden, Ala.

27—Net earnings of the United States Steel Corporation for the quarter ending Sept. 30 are reported as $21,310,417.

28—Ground broken for new six-mill sheet plant near Massillon, O.

30—Pig iron prices rule firmer in all markets and show tendency to advance.

31—Bessemer & Lake Erie railroad announces October iron ore shipments from Lake Erie ports, to Carnegie Steel Co. furnaces in the Pittsburg district to be 815,253 tons, the heaviest in history.

November.

2—Youngstown Sheet & Tube Co. blows in the first of its two new blast furnaces on Bessemer.

3—Bessemer average for October announced as $14.58 valley, lowest since October, 1905.

4—Orders for about 5,000 steel freight cars placed by different steam roads.

5—American Steel & Wire Co. takes over Donora steel works and blast furnaces operated by Carnegie Steel Co. and transfers Neville and Edith furnaces, Pittsburg, to that company.

6—Rail makers fix $28 base for Bessemer and $30 base for open-hearth as prices for 1909 delivery.

7—Pig iron prices advance sharply in Mahoning and Shenango valleys.

9—Republic Iron & Steel Co. buys Martin coke works of the Bessemer Coke Co.

10—Ocober pig iron production shown to be 1,573,824 gross tons.

11—November-December bar iron settlement fixed at a boiling rate of $5.25 per ton, based upon a 1.30c selling card. Sheet and tin plate settlements remain at base rates.

12—Atlantic coast line buys 25,000 tons of rails from the Pennsylvania Steel Co.

12—Bar iron makers advance prices to 1.50c mill in the Pittsburg district.

14—Independent sheet and tin plate makers reaffirm prices.

17—Nut and bolt makers advance prices 5 per cent.

18—President Corey states United States Steel Corporation will eventually extend facilities for manufacturing steel wheels in the Pittsburg district.

19—Announcement made of plan of the United States Steel Corporation to establish testing laboratory in Pittsburg district for the benefit of all constituent companies.

23—Iron and steel makers meet in New York and discuss tariff matters.

24—New furnace B of Youngstown Sheet & Tube Co. blown in on Bessemer.

25—Tariff hearings upon iron and steel material open at Washington.

27—Structural steel tonnage bid on in the year ending Oct. 31, stated to be 1,588,131 tons, of which 1,226,127 was built.

28—Wisconsin Steel Co. closes contract for 6,000 tons of furnace coke monthly for three year period beginning Jan. 1, 1909.

30—James Gayley, first vice president of the United States Steel Corporation, tenders his resignation.

December.

3—Iron ore shipments of the United States Steel Corporation for the season announced as 14,250,000 tons, a decrease of 8,300,000 tons from the preceding year.

4—Jones & Laughlin Steel Co. resumes operations upon the construction of additional Talbot open-hearth furnaces at its South Side Works, Pittsburg.

5—Receivership of Westinghouse Electric & Mfg. Co. is lifted.

7—November pig iron production shown to be 1,582,314 gross tons.

8—Harriman lines place orders for 1,870 adtional freight cars.

15—Announcement made of the resignation of President C. W. Bray, of the American Sheet & Tin Plate Co., effective Jan. 1, and of the election of First Vice President E. W. Pargny to that position along with other changes among officials of the company.

16—Pennsylvania railroad announces it has placed orders for 135,500 tons of rails for 1909 delivery. Chicago, Burlington & Quincy railroad closes contract for 40,000 tons.

18—Carnegie Steel Co. starts Mingo works after year's idleness.

21—First furnace, No. 12, of plant of Indiana Steel Co., Gary, Ind., blown in.

22—Total ore shipments from the Lake Superior regions announced as 25,427,094 tons, a decline of 15,861,661 tons over 1907.

24—Bookings of American Bridge Co. in year estimated at 250,000 tons and shipments

350,000 tons by reason of contracts held-over. Independents estimated to have produced 800,000 tons of structural material.

28—Iron ore on lower lake docks at the end of navigation shown to be 8,441,553 tons, with the yearly receipts 20,414,191 tons compared with 35,195,758 tons in 1907.

29—W. B. Dickson made first vice president of United States Steel Corporation, succeeding James Gayley, resigned. D. G. Kerr, ore agent of Carnegie Steel Co., made second vice president, vice Mr. Dickson.

Allis-Chalmers Activities.—The Allis-Chalmers Co. is busy at its West Allis plant on several large orders, among them one from the Reno, Nev., Power, Light & Water Co. For this concern the Allis-Chalmers Co. will construct a 1,200-horsepower horizontal twin turbine in cylindrical plate steel casing, with top inlet and center discharge, to operate under 41 feet head at 360 revolutions per minute. This will be connected direct to a 3-phase, 60 cycle, 4,100-volt alternating current generator. Both turbine and generator will be manufactured complete by the Allis-Chalmers Co. A big shipment of gas engines was made last week to Gary, Ind., by the Allis-Chalmers Co., which is furnishing this equipment for the Indiana Steel Co. The entire equipment was shipped by special train. At the office of the Allis-Chalmers Co. it is said that there are on hand many large orders for machinery and indications are that the company will enter the new year with approximately $15,000,000 worth of orders on its books.

Coke Property Sold.—G. W. Wilson, general manager of the Peerless Connellsville Coke Co., which owns the Carolyn operation near Alverton, Pa., has purchased a half interest in the property of the Brownsville Coke Co., near Brownsville, Pa., the seller being Geo. G. Gans, who was the sole owner of the plant. The sale includes a half interest in the entire property, consisting of 50 beehive ovens, about 38 acres of Connellsville coking coal and about an equal amount of surface. Following his sale of an interest in the Brownsville plant, Mr. Gans purchased a tract of more than 1,700 acres of coal land in Greene county, Pa. John N. King, who has been acting as superintendent of the Carolyn works of the Peerless Connellsville Coke Co., will manage the Brownsville plant.

The Arbuckle-Ryan Co., an Ohio corporation, has taken out an Illinois charter to deal in boilers, pumps and machinery at Springfield, with $200,000 capital.

STEEL BARS

Will be Rolled on Pacific Coast—Irondale Furnace Co. Reorganized.

James A. Moore, who returned to Seattle, Dec. 26, from an extended trip east, announces that the Irondale Furnace Co., of which he is president, has been reorganized and will hereafter be known as the Irondale Steel Co. The new corporation has a capitalization of $1,000,000 and a bonded debt of $500,000. Arrangements for the sale of these bonds have been completed. The new company will take over the entire assets of the Irondale Furnace Co., which include an 80-ton blast furnace and charcoal burning plant at Irondale, near Port Townsend, Wash.; about 2,000 acres of ore lands located on Texeda Island, B. C., and in Snohomish, Skagit and Pierce counties in Washington; and 2,000 acres of coal lands in Pierce county. Associated with Mr. Moore in the enterprise are N. H. Latimer, manager for Dexter, Horton & Co., bankers, J. E. Chilberg, president Scandinavian Bank, M. A. Arnold, president First National Bank and J. C. Eden, all of Seattle, also G. H. Whitcomb and N. W. Jordan, Massachusetts capitalists.

Mr. Moore stated that the plans for the open-hearth furnaces, on which work for the foundations has been going on since September, will be revised and that the furnaces will be enlarged to a capacity of 140 tons per day. Also the first rolling mill on the Pacific coast to manufacture mild steel bars will be erected at Irondale. About $400,000 will be spent on these projects and in improving the plant generally. It is hoped to have the new works running some time in the summer.

The coal properties, which are said to contain a good grade of coking coal, located in Pierce county on the Tacoma Eastern railroad, will also be developed at once. The company expects to build coke ovens and to manufacture its own blast furnace coke.

Mr. Moore also stated: "Ours will be the first complete steel plant to be erected west of the Rocky Mountains, and we are thoroughly confident of its success. Steel can be manufactured as cheap as at Pittsburg, quantities considered, for we can lay down our ore at Irondale cheaper than can the Pittsburg furnaces bring theirs from Minnesota. The coke costs about the same as it does at Gary, Ind. There is no field in the world today that holds out so many inducements to the manufacture of steel as the Pacific coast. More than 1,000,000 tons of iron and steel, outside of steel rails, are consumed on the Pacific coast annually. About 100,000 tons of this is steel bars, every ton of which is brought in from the east or imported from abroad.

"At the outset the British Columbia ore deposits will be used chiefly. We shall manufacture pig iron, and shall roll steel bars, light rails, channels and skelp, which will be used in a tube mill to be erected eventually at Irondale."

MAKING IMPROVEMENTS.

The rod mill of the Youngstown Sheet & Tube Co. was shut down the last of the year for about four weeks, during which time a new 2,500-horsepower Tod Corliss horizontal vertical engine of the latest improved pattern will be installed, instead of the small Tod engine that was sold to the Morgan Spring Works, and which will be taken out.

During the period of inactivity of the rod mill, the remainder of the nail and wire department will be operated to such capacity as engagements may warrant. The present products are barb wire, wire nails, smooth steel wires and staples. During the shut down for the making of improvements in the rod mill, there will be installed in the new addition, just nearing completion, other machinery which will materially increase the capacity and facilities in all kinds of wire products. The first unit of the new galvanizing plant will also be completed about Feb. 1, and the rod mill, under the new system to be inaugurated, will work double strands, increasing the capacity two-fold. These improvements will make the department modern and in a condition to handle a very large tonnage.

Good Furnace Record.—The Dunbar Furnace Co.'s stack No. 2, at Dunbar, Pa., made 81,728 tons of pig iron during the year 1908, of which 99 1/3 per cent was of standard grades, the only "off iron" being 24 tons of "white" and 530 tons of gray mottled. This stack up to Jan. 1 has made 158,388 tons in this blast and is now making about 250 to 300 tons of pig iron daily. "Dunbar" by-product coke is used exclusively for fuel, being made in Semet-Solvay retort ovens just adjoining the furnace plant.

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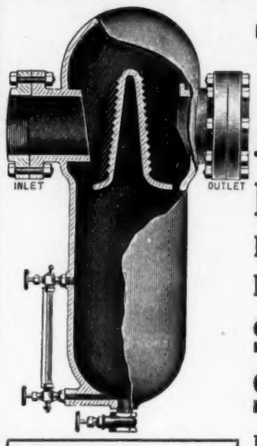

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Fig. 300

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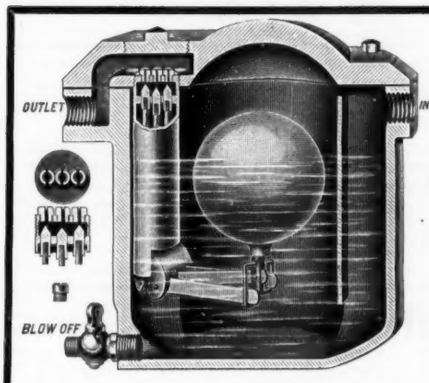

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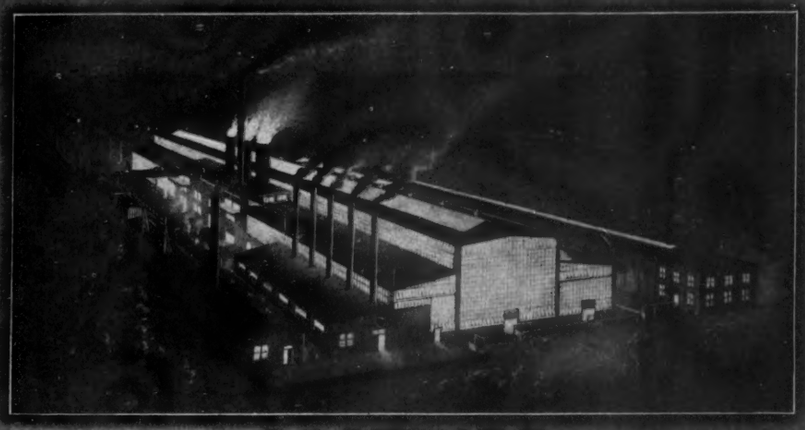

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Interstate Engineering Co., Cleveland, O.
McClintic-Marshall Construction Co., Pittsburg, Pa.
Scaife, Wm. B., & Sons Co., Pittsburg, Pa.

BRUSHES (Foundry).
Obermayer, S., Co., Cincinnati, O.
Smith, J. D., Fdry. Supply Co., Cleveland, O.

BUCKETS (Clam Shell).
Interstate Engineering Co., Bedford, O.
Macbeth Iron Co., Cleveland, O.
McMyler Mfg. Co., Cleveland, O.
New Jersey Fdry. & Machine Co., New York City.
Wellman-Seaver-Morgan Co., Cleveland, O.

BUCKETS (Elevator and Hoisting).
Bartlett, C. O., & Snow Co., Cleveland, O.
Brown Hoisting Machinery Co., Cleveland, O.
Caldwell, H. W., & Son Co., Chicago, Ill.
Jeffrey Mfg. Co., Columbus, O.
McMyler Mfg. Co., Cleveland, O.
Ohio Malleable Iron Co., Columbus, O.
Palmer-Bee Co., Detroit, Mich.
Scaife, Wm. B., & Sons Co., Pittsburg, Pa.
Wellman-Seaver-Morgan Co., Cleveland, O.

BUGGIES (Wire and Nail Mill).
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O.

BULLDOZERS.
Cleveland Punch & Shear Works Co., Cleveland, O.
Long & Allstatter Co., Hamilton, O.
National Machinery Co., Tiffin, O.
Williams, White & Co., Moline, Ill.

BULLDOZERS (Hydraulic).
Chambersburg Engineering Co., Chambersburg, Pa.

BURNERS (Fuel Oil).
Petroleum Iron Works Co., Sharon, Pa.

CABLEWAYS.
Flory, S., Manufacturing Co., Bangor, Pa.
McClintic-Marshall Construction Co., Pittsburg, Pa.

CARBORUNDUM.
Carborundum Co., Niagara Falls, N. Y.

CARS (Annealing, Pig Iron, Etc.).
Chase Foundry & Mfg. Co., Columbus, O.
Smith, J. D., Fdry. Supply Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Youngstown Car Mfg. Co., Youngstown, O.

CARS (Billet).
Atlas Car & Mfg. Co., Cleveland, O.
Chase Foundry & Mfg. Co., Columbus, O.
Youngstown Car Mfg. Co., Youngstown, O.

CARS (Charging).
Atlas Car & Mfg. Co., Cleveland, O.
Chase Foundry & Mfg. Co., Columbus, O.
Youngstown Car Mfg. Co., Youngstown, O.

CARS (Coal, Coke and Mining).
Jeffrey Mfg. Co., Columbus, O.
Massillon Fdry. & Machine Co., Massillon, O.
Youngstown Car Mfg. Co., Youngstown, O.

CARS (Electrically Driven).
Atlas Car Mfg. Co., Cleveland, O.
Jeffrey Mfg. Co., Columbus, O.
Westinghouse Machine Co., E. Pittsburg, Pa.

CARS (Industrial).
Atlas Car Mfg. Co., Cleveland, O.
Chase Foundry & Mfg. Co., Columbus, O.
Youngstown Car Mfg. Co., Youngstown, O.

CARS (Tank).
Meehan Boiler & Construction Co., Lowellville, O.
Standard Boiler & Plate Iron Co., Niles, O.

CASTINGS (Auto).
Acme Steel & Malleable Iron Works, Buffalo, N. Y.
Canton Brass Co., Canton, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Ohio Malleable Iron Co., Columbus, O.
Walker Foundry Co., Erie, Pa.